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TROPICAL DISEASES BUREAU.

TROPICAL DISEASES BULLETIN.

Vol. 7.] 1916. [No. 7.

APPLIED HYGIENE IN THE TROPICS.

By Colonel W. G. King, C.I.E., I.M.S. (Retired).

REPORTS.

Straits Settlements (1914).*

This is written by Dr. W. Gilmour Ellis, Principal Civil Medical Officer. In discussing the fluctuation of population, he notes that the total strength has been affected by the repatriation of 11,000 coolies and others to China and India in connection with war requirements. The estimated general population was 759,105. The birth-rate for 1914 was 29·09 against 26·87 for 1913 per mille. The European population for 1914 is estimated at 7,883, with a birth-rate of 24·61 and a death-rate of 12·43 per mille. The death-rate of infants of the general population per mille of births was 250·23. In Singapore, plague caused 13, and cholera 240, deaths. A total of 101 deaths was recognized as due to typhoid. Deaths from beriberi per annum have declined as follows: 2,056, 1,926, 1,657, 1,483.

The subject of ankylostomiasis is receiving increased attention in the hospitals, 1,131 being treated in 1914 against 320 in 1910.

Owing to restriction of immigration, the Singapore quarantine station was little used for its normal function, but was usefully employed for receipt of enemy prisoners of war. On the other hand, the station at Penang had a busy time, as the pilgrims from Mecca returned in infected ships. A total of 13,682 pilgrims, with 54,728 packages of luggage, were dealt with, and 20,000 vaccinations were performed.

*The Straits Settlements Medical Report for the Year 1914.

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DISEASE PREVENTION.

Malaria.

Malaria in a Hospital.

In St. George's Hospital, Bombay City, malaria was found not to confine itself to the patients admitted for other diseases but to make attacks upon the nursing staff. A strong Committee was appointed by the Bombay Government to investigate the subject and submit recommendations. They found that in an average monthly strength of 63 nurses, five were attacked.

This Hospital is situated in Ward A of the Bombay City. In 1910, Dr. Bentley's examination of 52,000 children according to locality gave the following spleen indices* :—

Ward.	Number of Children examined.	Number of Children with enlarged spleens.	Percentage with enlarged spleens.
A	5,944	1,783	29·9
B	5,980	781	13·0
C	12,025	711	5·9
D	7,532	208	2·7
E	11,646	213	1·8
F	5,513	66	1·1
G	3,896	41	1·0
Totals	52,536	3,803	7·2

Two years subsequently, the spleen index was 33·5 in A Ward. By 1913, it had declined to 15·87 and in 1914 to 13·77. In the Hospital compound, however, it was as high as 27. The Committee found that they were really called upon to pronounce an opinion upon conditions which had already been greatly improved, the improvement however being still incomplete. They therefore discovered no matter on which to place particular weight, but made the following observations† :—

"There can be little doubt that the anti-malarial measures which have been enforced (in the city of Bombay) have been largely responsible for the improvement in the health of the neighbourhood on which we commented in the previous section of our report. . . . It is necessary, however, to point out that the success of the campaign against malaria will depend greatly on the continuance of the work which is at present so energetically pursued by the Health Department. We would urge therefore that they should be encouraged to press forward all works which will be of permanent utility in the prevention of malaria, especially the covering of wells and cisterns in the infected areas. Unfortunately, there still remain a certain number of breeding places for *Anopheles stephensi* over which the Municipal authorities can have little control, *viz.*, collections of water stored intentionally or unintentionally in the houses of the inhabitants of the neighbourhood. Every effort therefore should be made to enlist the sympathy and support of the people themselves in the fight against malaria. They should particularly be encouraged to

*Administration Report of the Municipal Commissioner for the City of Bombay for the Year 1914–15. Vol. II. Annual Report of the Executive Health Officer for 1914. p. 99.

†*loc. cit.* p. 101.

thoroughly treat all cases of malaria with quinine, for it is evident from the number of children, who are still found in the neighbourhood suffering from enlarged spleens, that many cases of malaria are ineffectively treated, and the danger of these cases lies in the fact that they are the source from which mosquitoes acquire their infective power."

In addition, they considered the question of rendering the whole hospital mosquito proof, but, having found this would cost Rs. 67,000, advised that a ward of 14 beds and one private ward be adapted at a cost of Rs.3,727.

Open Wells and Malaria in Bombay.

The following is quoted from a Press notice issued by the Municipal Commissioner, Bombay* :—

"It may be stated at once that no action has been taken in regard to any well unless it is found to be infected with mosquito-larvae. Out of the 3,313 wells, in A, B, C, D, and E wards, these larvae have been found in 2,202 which have been treated as follows :—

"348 have been filled in.

"770 have been hermetically covered—123 of which have been provided with hand-pumps.

"834 have been covered over with trap-doors allowed.

"In addition to these, 250 wells are under legal action, 16 for filling in, 108 for hermetical covering and 126 for hermetical covering with trap-doors allowed. It should be stated that nearly all of those that have been filled in entirely were altogether bad—many of them had not been used for many years for any purpose whatsoever and the owners made no objection to their being filled in. As regards those which have been hermetically covered, hand-pumps have been allowed in all cases in which owners desired to put them. . . . The permission to use trap-doors is, of course, open to very serious objection, from the point of view of efficient anti-malarial prevention. Trap-doors are constantly left open and frequently allow the entry of mosquitoes either through original bad fitting, or through defects in or injuries to the frame work. Out of 834 cases in which the trap-doors have actually been put in, in 119 within the last six months, action has had to be taken, because owing to imperfect closing of the trap-doors, the wells were found to be infected with anopheles larvae. The Standing Committee have, however, preferred that this risk of malaria infection should be undergone rather than that any religious prejudice of the people should be in any way offended, and have dealt with these cases with consideration and leniency. . . .

"It has now to be seen what good results have followed from the action that has been taken. This action has been, as will be gathered from what has been written above, only partial and not such as could be expected to produce entirely satisfactory results. Nevertheless the following table which is extracted from a report prepared by the Health Officer on the 7th May 1914 shows the improvement that has taken place :—

Ward.	Parasite Rate.			Mortality from Malaria.		
	1910.	1912.	1913.	1910.	1912.	1913.
A	34·8	10·54	2·98	80	91	65
B	13·1	3·01	2·89	78	101	47
C	34·5	14·14	1·88	50	58	53
D	3·8	0·00	0·00	29	22	24
E	3·8	7·97	5·45	37	56	47

*Administration Report of the Municipal Commissioner for the City of Bombay for the Year 1914–15. Volume II. Annual Report of the Executive Health Officer for 1914, p. 106.

Bengal. Malaria and Agriculture.

Dr. BENTLEY, on the transfer of Major CLEMESHA, I.M.S., to the position of Sanitary Commissioner with the Government of India, now holds the post of officiating Sanitary Commissioner for Bengal. According to a Review of five public lectures, given by him, in the *Statesman* (Calcutta) of the 19th February, *et seq.*, Dr. Bentley finds there are papers "quoting the anti-malaria work done in America, Formosa, Ismailia and other places, and asking why measures of a similar nature should not be adopted in Bengal," also that "numerous remedies have been prescribed by different people. . . . The first of these was drainage, because some people thought water-logging was at the bottom of it, ... Another favourite remedy put forward by sanitary quacks was the clearance of jungle." Dr. Bentley having thus trodden on the tails of the coats of the "different people" and sanitary quacks who do not accord with his views, proceeds to show how "the disease must first be properly diagnosed and then the correct remedy applied." He considers "quack sanitation worse than useless."

Just as Dr. Bentley discovered that domestic wells afford shelter to anopheles mosquitoes in Bombay, subsequent to a similar statement some years previously by Major CORNWALL, I.M.S., in the City of Madras, so now he has brought again to notice the ancient fact that a sheet of water on land is more protective against malaria* than a series of puddles; the correct explanation of which phenomenon awaited Ross, and details of the bionomics of the mosquito. On this one fact he founds much theory. He argues that the quack sanitarian forgets that the area of Bengal dealt with is not dry and elevated but delta land, that the cost of drainage is "prohibitive" because it entails pumping and, in any case, is unnecessary; as shown in the fact "staring them in the face that in those parts of Bengal where there was water-logging there was little or no malaria." His audience was assured that they must not make the mistake of supposing that "all the pools of stagnant water round Calcutta were the cause of malaria, or that by doing anything to them they would reduce malaria." He held that in dry elevated countries a little introduction of water might bring about an increase of malaria. The remedy there was to remove the water by drainage or some other means, but "in swampy countries like Bengal . . . instead of mending matters they would make things much worse."

In accord with this diagnosis Dr. Bentley declared "*the only remedy which could possibly have a beneficial effect in Bengal was the introduction of more water on the land surface.*" He considers the delta lands of the South of India owe their diminution of malaria to the introduction of large supplies of water under irrigation systems. No statistics are quoted to support his statement. So far as the Godavery District is concerned, in such statistics the hill tracts would have to be differentiated from the delta land; as to the Cauvery area, he refers to the great malaria epidemic of 1809–11 which, unfortunately for his theory, was distinctly the *aftermath* of extraordinary floods. Kyaupyo in Burma, which is naturally neither dry nor elevated, is another excellent

*[Major CHRISTOPHERS, C.I.E., does not accept this as to the Punjab.]

specimen of results of impounding water for irrigation; from being a favourite garrison for European troops, it has been degraded to a place of deadly malaria.

Now even quack sanitarians who favour drainage as an important, but by no means only anti-malarial method, are likely to be able to recognise that delta land under process of formation and formed land, respectively, cannot be expected to yield the same results as to mosquito propagation, in the presence of varying grades of surplus soil and surface moisture, and are likely therefore to require different engineering methods for relieving surface and subsoil water. On this subject, Reports* reviewed in this *Bulletin* [Vol. 4, No. 4, p. 180 (Sanitation Number)] give much information as to Bengal soil and subsoil configuration. Indeed, space in this Note is saved by the writer referring not only to this Review† but to a letter in the *Statesman* of February 19th 1916, which, with the intention of defending Dr. Bentley, really gives his panacea away. The chairman at one of Dr. Bentley's lectures had stated he did not think the lecturer's views of water-logged areas agreed with his theory of decreased malaria, and illustrated this by citing the malaria stricken condition of Perojepur. The correspondent (H. P. Ghose) then shows, "because Perojepur is a sub-division of Backerganj [an area liable to flood] it does not follow that it is inundated during the rains. As a matter of fact Perojepur is a sub-division of dying rivers and silted up channels." The vast difference necessary for the treatment of formed and still incompletely formed delta land (emphasized in the Review in the *Bulletin* above referred to) should suffice to show the simple fact that not provinces, but each petty area of a country possessed of an inhabited place to be protected must, within the possible flight of the mosquito, be regarded as the unit of sanitary survey and advice founded thereon, and consequently the usual formula of regarding the cost of drainage as "prohibitive," must take recognizance of estimates on reasonable data.

But, according to Dr. Bentley, floods and silt would restore agriculture to areas denuded of population and, therefore, a prosperous population would get rid of malaria. The efficacy of his panacea, with such mixed condition of soil, subsoil and physiography as presented by Bengal, however, Dr. Bentley evidently considers requires support; and assuming prosperity due to better agriculture as an effect of his method, he claims thereafter the disappearance of malaria. He quoted Ross for his support on this point—"it might happen that when the human population increased the local breeding of mosquitoes had reached its maximum output, in which case a decrease in the static mosquito ratio should result."‡ But whilst dilution of intensity of incidence by increased population is thus explainable, it is not apparent that Ross has suggested importation of human beings into a malaria stricken area by way of remedy. Moreover, the assumption of increased agricultural prosperity under conditions of water-logging would seem particularly ill founded; unless the elaborate experiments conducted by the Agricultural Department of India at Pusa and Madras are worthless, *soil aeration in agriculture is of prime importance.*

---

* Stewart and Procter; Fry; Drainage Committee.

† At p. 190 in this Review, at the 8th line of the second paragraph, instead of "in the khals of a permanent character" read in the "bheels."

‡ Statesman, 6.2.16.

Consequently, in the absence of either natural or artificial means to secure entry of air into the soil in place of the water-filled voids of earth, the chances of agricultural prosperity are remote. Indeed, it is reasonable to believe that it has been in the attempt to realize this necessity that the agriculturist has shown throughout the world that successful agriculture, drainage and the abolition of malaria go hand in hand.

Irrespective of parts of Bengal to the East being of the type of recent delta formation and, therefore, in contrast with the older and formed portions to the West possessed of dead and dying rivers and peculiarities of physiography, and the consequent requirements of special methods for relief of surface and subsoil waters, a fact mentioned by Major CLEMESHA, in his Report on Sanitation in Bengal 1914, is worth remembering as to opportunities of extension of malaria in the East part of Bengal; he states [p. 16] that, in Western Bengal, the population is collected in large and compact villages, in areas well supplied with roads; "whereas villages in East Bengal usually cover a large area, individual houses are often widely scattered, and the few existing roads are often unpassable at certain times of the year."

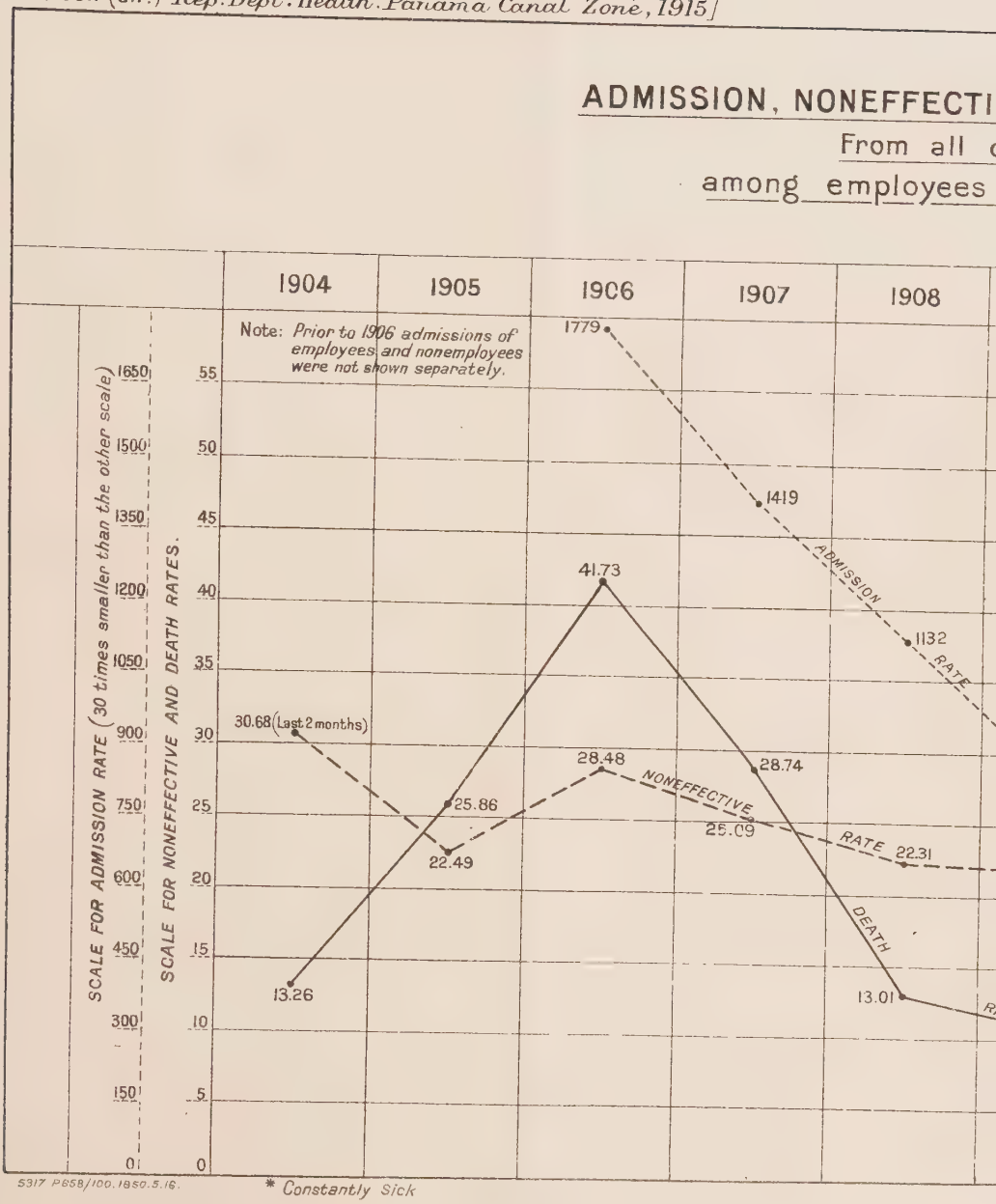
In the meantime, whilst Dr. Bentley warns against quack sanitarians, and advises that it would be a mistake to suppose that "all the pools of stagnant water round Calcutta were the cause of malaria or that by doing anything to them they would reduce malaria," it is reported that of men making munitions in a factory at Ichapur, one thousand out of three thousand employed in January were absent owing to fever. In the Report just referred to, Major CLEMESHA states that, in Bengal, an increase of deaths from "fever" has been registered as follows:—1912, 959,193; 1913, 963,546; 1914, 1,061,041. It is satisfactory therefore to find that the Government of India is about to require a definite opinion as to feasible action from the various experts it has employed since 1909. In the meantime, the sale of quinine to the population of Bengal has been successfully increased without a diminution in fever mortality demonstrable by statistics.

Tadpoles and Larvicides.

On this subject the following extract from the Medical Report of the Straits Settlements for 1914, pp. 123–124 is of interest:—

"Amongst means employed for the destruction of mosquito larvae other than drainage and oiling, the stocking of suitable sites with larvae-eating fish and, suggested from Pennsylvania, the employment of ducks are measures which are of value and have their undoubted uses. Lately it has been suggested that in the Bahamas* tadpoles are responsible for the absence of mosquito larvae in certain sites. This, if the case in the Bahamas, does not seem to apply to the tadpole of the frogs of Singapore, the most common species of which is *Rana limnocharis*. Commonly one meets tadpoles and mosquito larvae developing in the same site; and in experiments made the tadpole did not devour mosquito larvae—either anopheline or culicinine. It is necessary to make a distinction between these two in this connection for the former larva in rest lies parallel with the surface of the water and it might be a difficult feat for a tadpole to seize a larva especially if one notes the position of the tadpole's mouth, except when the larva dives. On the other hand culicine larvae rest with their bodies at an angle to the water surface and could be readily seized by a tadpole. But I have seen such larva (stegomyia) remain confined in a small space with tadpoles unharmed for over 14 days."

*[See this *Bulletin* (Sanitation Number). Vol. 4. p. 420.]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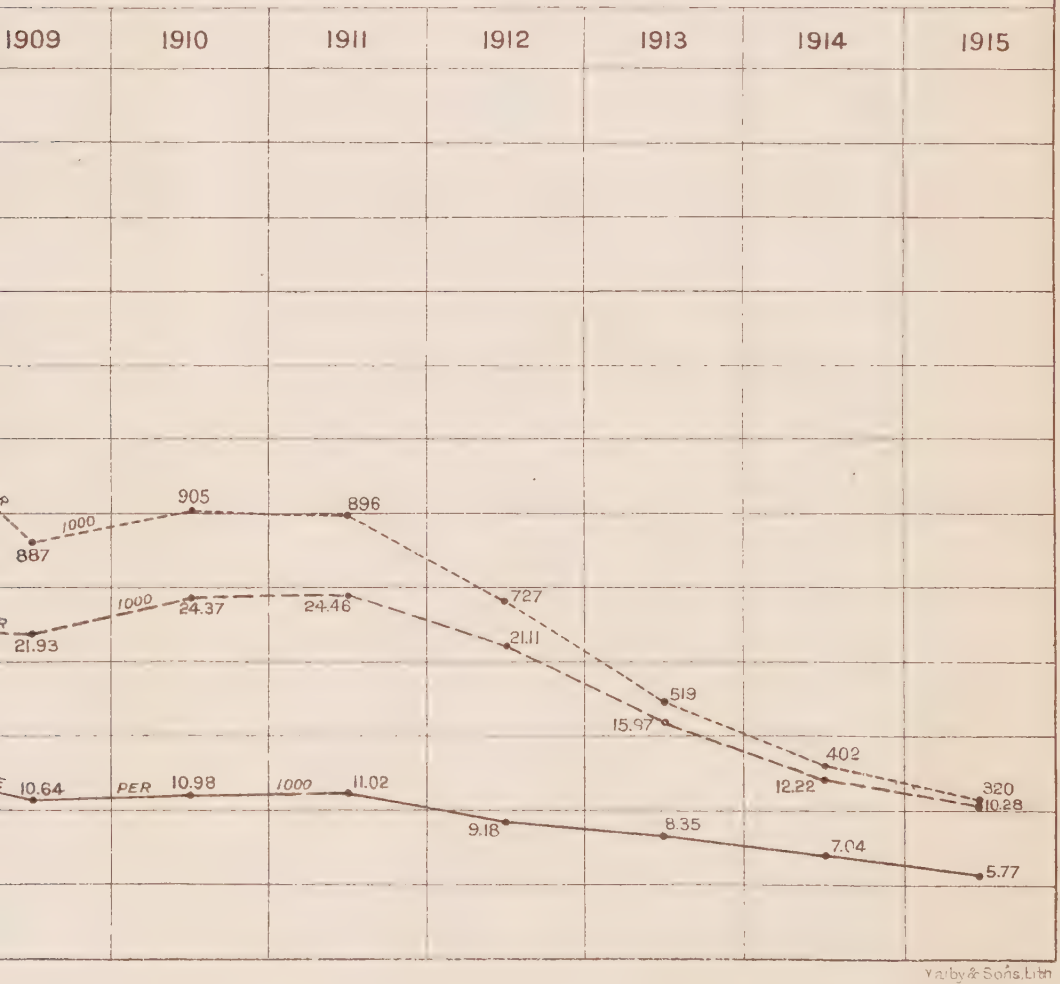

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Sanitary Measures on the Panama Canal.

The annexed chart requires no text to convey its meaning. It is reproduced from the Report of Lt.-Col. Mason, in the Department of Health, Panama Canal, for 1915. Irrespective of the splendid results of sanitary effort by Surgeon-General Gorgas and his successor, the chart forces upon observation the rapidity with which the change for the better was effected. It affords a clear proof of the effect of masterly organization.

The Wily Mosquito.

Since Ross definitely inculpated the mosquito in malaria spread, its methods of ambush have been a constant source of surprises to investigators. The *Mansonia titillans*, according to the Report of the Department of Health, Panama Canal, for December 1915 (p. 8), in its early days, resorts to submarine methods. Lt.-Colonel Mason, Medical Corps, U.S.A., states that study of the breeding habits of this and allied mosquitoes is progressing. The question is of some importance since the larvae do not come to the surface but remain attached to roots of plants, and are therefore difficult to kill. The same authority, in his Annual Report for 1915, is by no means confident that, notwithstanding ten years labour to circumvent the mosquito in Panama City, complete absence has been secured. Thus both trains and tram cars have been found to import mosquitoes. Granted a train starts from Colon with no mosquito apparent, it arrives with a number proportionate to the stops and length of time of such stops. Small sailing vessels are also liable to aid importation by "water containers" on board being utilized by mosquitoes. He believes also that invasion occurs from a distance of two miles. So fully does the mosquito appreciate even a hollow caused by the footprints of cattle as a water receptacle, that it has been found necessary to impound "all cattle found straying on wet or marshy places." In September 1915, 1,744,400 square feet of jungle clearing was carried out with the result of many mosquito breeding places being reached; this was followed by the taking of measures which secured a rapid diminution. In Bella Vista, 15,000 feet of ditches were formed, so that at present it is not uncommon to spend an entire evening at Bella Vista without "encountering a single mosquito."

In his Report for December, 1915, Lt.-Colonel Mason states that punching holes in roof gutters will fail to ensure their not proving breeding places, owing to subsequent obstruction of these outlets by paper, leaves, rubbish and dust "converting them into containers." During that month, it was found necessary to remove 7,842 feet of roof gutters.

Plague.

Hydrocyanic Acid Gas Fumigation.

Important experiments have been carried out by officers of the U.S. Public Health Service on the above subject.* The question of

*Surgeon R. H. Creel, Assistant Surgeon F. M. Faget, and W. P. Wrighton, Sanitary Engineer. Hydrocyanic Acid Gas—Its Practical Use as a Routine Fumigant.—*U.S. Public Health Reps.*, 1915. Dec. 3. Vol. 30. No. 49. pp. 3537–3550.

cost when compared with that of sulphur dioxide and carbon monoxide, the relative power of penetrability of these gases and their danger to human beings during employment, engaged their attention. It was considered that both in regard to cost and danger to human beings, the minimum strength found efficacious in killing rats must be a leading consideration. The conclusion was arrived at that, instead of 10 oz. cyanide of potassium per 1,000 cubic feet of space, half that amount was all that was requisite. Efficiency was aided by the employment of powdered cyanide of potassium, instead of the solid form. In regard both to the cyanide and to the sulphuric acid employed, they found no reason to prefer chemically pure material to the common commercial products. Compared with sulphur dioxide they ascertained that hydrocyanic gas had greater penetrability,* and was more rapid in action; so that whereas six hours' exposure to the former would be necessary, the latter would secure full results within one hour. As regards danger to human life, the matter had to be considered in relation to the time that must elapse before entry could be made into a space recently fumigated, and the chances of contact with the gas during its first disengagement in a room or hold, if the operators be liable to be delayed by any manipulation of ingredients. On the first point, they concluded that [p. 3547] in any space where a circulation of "natural air currents can be obtained, there is no danger to men entering a place fumigated by cyanide gas 30 minutes after apertures have been opened. This interval of time is shorter than in sulphur fumigation, where the fumes are not sufficiently cleared from ships' holds for men to enter for varying periods of from one to three hours."

On the second point, they assert that "ordinary speed in departures from the room will likewise safeguard the operators in fumigations on land, when the cyanide is dropped by hand. . . . In the fumigation of a large warehouse the operators had to travel 100 feet from the container to the exit. This was accomplished without any noticeable effect."

To get over the difficulty of quick escape from ship holds before the closing of hatches, a simple but effective apparatus was devised by the officers concerned, which is thus described:—

"A. Ordinary wooden barrel, open at top, as the container for water and acid solution.

"B.-C. Five gallon tins, with tops removed, and pin hinges placed on one side 2 inches below the top, made to fit similar hinges on sides of D. These tins hold cyanide.

"D. Funnel of galvanized iron, 23 inches diameter at top, 12 inches perpendicular depth, 6 inches opening at bottom, series of 1-inch holes on sides opposite to hinges; hinges extending 2 inches above rim of funnel. It is intended that the acid and water mixture be placed in the barrel before it is lowered into the hold, the funnel to be then placed at the top of the barrel and the tins containing the cyanide attached to the funnel by means of the pin hinges. Ropes are attached to the bottom of the cans and passed over hatch combings. By simply pulling these ropes the contents of the cans are dumped into the barrel."

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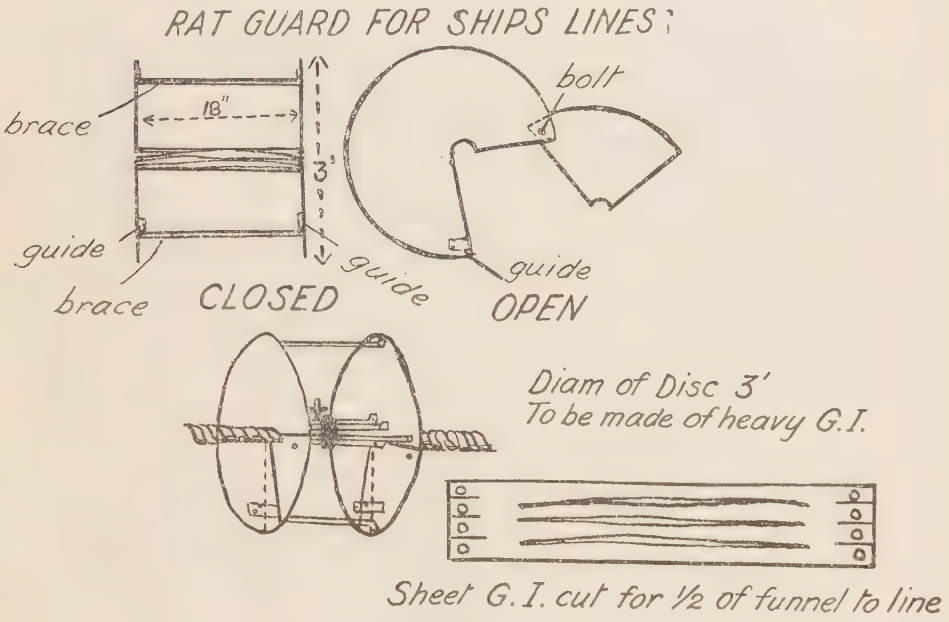
*On this point see this *Bulletin* [Sanitation Number], Vol. 5, Feb. 1915, p. 160.

Rat Guards.

Surgeon MANNING* suggests an improved rat guard; the plan given below may be compared with that shown at p. 371 of this *Bulletin* [Sanitation number, Vol. 3. No. 7]. It is thus described :—

"This rat guard is made of two disks of galvanized iron 3 feet or more in diameter, joined by four rods or braces of galvanized iron and a funnel made of sheet galvanized iron.

"Each disk is made up of two segments as shown in the diagram, or the disks can be cut as in the Fox rat guard [*loc. cit.*], and joined on one side by a bolt that acts as a hinge, a socket being provided to lock the two segments on the other side. The two disks are joined at the centre by a funnel made of sheet iron. The funnel is made up of two halves, one of which joins on the one side the two large segments of the disks and on the other the smaller segments. The central part of the funnel has long segments cut out as shown in the diagram [see figure].



"After closing the guard over a ship's line, the central part of the funnel is tied to the line by a small piece of rope. This fastens the rat guard to the ship's line so that it cannot slip and completely closes the funnel and locks the two halves of the rat guard.

"The advantage of this rat guard is that it is always at right angles to the ship's line, and it would take considerable force to deform it or to flatten it out so that a rat could easily get over it. Also this guard is easily stored away without any danger of damaging it."

Madras City and Plague.

The following is a concise review of the Ninth Report of the present Indian Plague Commission by the Health Officer, Madras,† (Dr.

*U.S. Public Health Reports. 1916. Apr. 7. Vol. 31. No. 14.

†Report of the Health Officer, Corporation of Madras, Health Department for 1914, p. 35.

Macdonald, B.Hg., D.P.H.). Incidentally, it refutes the extraordinary idea propagated in literature on plague in India that such cases as have occurred in Madras City have been exclusively imported, and that no indigenous epidemic has occurred. After remarking upon the increased difficulties to be faced by the Sanitary staff in tracing importation of plague under certain recent relaxation of rulings, he states :—

"No one who is responsible for the health of the city would rest secure on the supposed natural protective advantages of Madras, from its climate, and its low elevation. The fact that there have been, so far, 103 *indigenous cases of plague* (italics not in original) in this city, coupled with the high susceptibility to plague of the Madras rats, gives us no faith in the theory of natural immunity of Madras against plague. Colombo may serve as an example of this supposed immunity proving unsafe to be relied upon."

Haffkine's Anti-plague Vaccine.

Embodied in the "Reports on plague operations in the Shwebo, Sagaing and Lower Chindwin Districts" (Rangoon: Superintendent, Government Press, 1915), forwarded by the Sanitary Commissioner to the Government of that Province, is a Memorandum by Lt. C. G. Crow, I.S.M.D., pointing to the great advantage of anti-plague vaccine—when accepted whole-heartedly by the people concerned. This condition was secured, in this particular instance, in a town of small population, 10,937, by the personal influence and enthusiasm of the officer concerned. His advocacy of taking the people into confidence as to delay of the highest stages of immunity instead of (as is so often the tendency with those urging inoculation) promising absolute freedom from attacks, and the mode of introduction of plague into Sagaing town (twice repeated) are noteworthy :—

"For general purposes it will suffice to discuss only . . . Ratting, Trapping, and Disinfection.

"Results in Sagaing have clearly shown that these measures were total failures.

"In 1907, 1909 and 1910 large gangs of coolies were entertained at enormous expenditure. . . . All measures were thorough and sustained.

"The results were unsatisfactory; besides doing considerable damage to house property, the death-rate was high. The disease was scattered throughout the town by these driving methods.

"A glance at the plague incidence will prove my statement.

1907 and 1908 = 63 attacks
1909 and 1910 = 153 attacks
} as compared with
1913 and 1914, present epidemic = 9 attacks.

"*Trapping* was systematically carried out in the town. Trapping squares were made with considerable labour, and things worked like clockwork. Eight hundred traps were in continuous use. The check to the rat population and plague epidemic was practically *nil*.

"The expenditure of buying traps, their upkeep and staff was considerable.

"*Disinfection* was carried out in all infected houses, without any apparent benefit.

"*Inoculation and evacuation.*—Inoculation was first started in 1907, and as was to be expected was very unpopular.

"Meetings were held and officials readily came forward, with their wives and families, and had themselves inoculated as examples; with all this only 820 cases were inoculated. Among these 820 not a single case of plague occurred and this fact helped us considerably in dealing with the next epidemic, 1909–10. Here again a good deal of opposition was

experienced, but by continual preaching and personal influence 4,284 people were done. Out of these 19 contracted plague and only 7 died. Out of the 7 deaths, 4 deaths took place from plague on third day after inoculation.

"Now this might be brought up as an argument against inoculation but it was not so, as the action of the plague prophylactic vaccine was clearly explained and great stress was laid on the fact that complete immunity was not guaranteed and that immunity was only practically conferred after the tenth day. Also it was explained that those contracting plague after the tenth day took a better chance of recovering than those not inoculated, and this is clearly borne out by our figures, much to the astonishment of the people. It was the fact that the whole action of the vaccine was thoroughly explained and prophesied, if I may use the term, that saved inoculation in Sagaing.

"The figures are as follows :—

Inoculated = 4,284.
Attacked with plague = 19.
Deaths from plague = 7.
Four deaths already explained.
Not inoculated = 4,467.
Attacked with plague = 134.
Deaths from plague = 128.

"The figures speak for themselves. Inoculation is so popular in Sagaing that it is now no longer found necessary to coax the people.

"In 1911, when plague threatened, 8,200 were inoculated, which is 78 per cent. of the total population. This will stand out as a world's record in the history of inoculation, except in the case of 1913–14, *i.e.* (the present epidemic), when 90 per cent. of the total infected area was inoculated."

"*Mode of Infection* (1914).

(1) Sagaing :—

Indigenous :	Attacks = 7	Deaths = 7.
Imported :	Attacks = 2	Deaths = 2.

Population = 10,937.

Plague was introduced into Sagaing by a dyer* of *pongyi* robes. It was ntroduced by the same man in 1906 and in the same way. Two boxes of old *pongyi* robes were sent from Kemmendine to Sagaing for renewing and dyeing purposes. These boxes contained two plague rats. The rats in this house were first infected and rat plague was subsequently spread to neighbouring houses. The infection was introduced early in January and was only known to us in the third week. On opening the house, no fewer than 20 dead plague rats were found."

Typhoid.

Queensland.

In the Annual Report of the Commissioner for Public Health (J. I. Moore), Queensland, up to June 1915, it is reported (p. 66) that the Kargoolnah Shire Council has issued a special pamphlet urging the use of anti-typhoid vaccine, which is prepared and issued free by the Government Health Department. The Commissioner states (p. 4) that during his tours he has urged this subject upon the special attention of local authorities. The following is an extract from the circular referred to, addressed to "shearing contractors and others" :—

"1. That all station managers, at least a fortnight prior to date of commencement of shearing, notify the Clerk to the Kargoolnah Shire Council, by letter, of the proposed date, and that the doctor proceed to the shearing

*The dyeing of Buddhist priests' robes is a speciality in this town. In 1906, the robes to which infection was traced, had been brought from Rangoon.

site and inspect the premises and make suggestions, if necessary, for the improvement of the Sanitary conditions. 2. That every shearer, shed hand, musterer, and general station hand submit to inoculation against enteric."

Trinidad and Tobago.

The Report of the Surgeon-General (H. L. CLARE) for 1914–15 (p. 8) shows the incidence of typhoid in this area :—

	" Number of Deaths.	Rate per 1,000 living.	Proportion per 1,000 deaths from all causes.
1912–13 ..	152	0·44	14·8
1913–14 ..	104	0·29	12·08
1914–15 ..	163	0·46	18·37."

These are but figures for registered deaths. The Surgeon-General considers that if the full figures were available " four times the number of deaths in each year would not be an extravagant estimate of the number of cases." After pointing out that existing legislation gives sufficient powers, he urges the prime importance of prompt notification. In the " Report of the Colonial Hospital, Port of Spain," which is embodied in the Surgeon-General's Report the following (p. 42) emphasizes this aspect of the subject :—

" It not unfrequently happens that an enteric fever case is admitted from a house where there have been shortly before one or more cases under the care of a private practitioner with whom no obligation lies to report to the Sanitary Authority. The danger of the spread of enteric fever to those nursing or coming into contact with patients is a serious one, though so much disregarded. To illustrate this point I may here remark that one of our nurses contracted the disease in hospital, where the danger is fully appreciated and every precaution taken to prevent infection. There was also a case of a patient contracting the disease in the institution. To better control this risk, certain proposals have been made to redistribute the patients so as to reserve a special ward for enterics."

British Guiana.

The following figures from the Report of the Surgeon-General (K. S. WISE) British Guiana, for 1914–1915 (p. 12) justify his warning conveyed in a former report of the importance of checking spread of typhoid, and of the necessity for special vigilance in the City of Georgetown :—

Year.	Death from fevers in the whole Colony.
1901–1905	4
1906–1910	28
1911	76
1912	93
1913	106
1914	100

He is now able to report that, in the City of Georgetown, efforts are made to secure " prompt isolation and equally prompt disinfection of patients' premises," and that a special isolation block has greatly assisted these ends, " the majority of all persons suffering from enteric fever " being isolated there.

Cairo.

In this City, with an estimated population of 725,650, the incidence of typhoid cases was 1·941 per mille, compared with 1·017 per mille in 1913. This increased rate the Medical Officer of Health, City of Cairo, does not consider necessarily implies increased incidence; but is due to discovery of cases following orders to his staff to do their best to ascertain *the nature of cases of sickness* occurring in the houses of the poor and insanitary. This has resulted in an increase of numbers of cases admitted to Hospital (Annual Statement Report: Department of Public Health, 1914, Ministry of the Interior, Egypt, 1914).

Accepting, therefore, the Medical Officer of Health's suggestion that no actual increase of typhoid has occurred, it is satisfactory to find that, after many years of contention as to what system was to be used for lifting sewage in the flat area concerned, by April, 1915, the Shone system was installed, under Mr. JAMES, late Engineer, Bombay City.

Hawaii.

Results of anti-typhoid vaccination and statistics of typhoid amongst troops in the British Army have been at times held to be more favourable than the facts warrant, were it possible to exclude paratyphoid. Definite action in this direction, under the advice of Surgeon G. W. McCOY, Sanitary Adviser to the Governor, has been adopted in Hawaii. It has been ruled that cases are not to be reported as "para-typhoid" unless the diagnosis is supported by the result of the laboratory examination" and, further, that convalescent and recovered cases are to be kept under the control of the Board of Health, so long as the bacilli are being eliminated." (Annual Report, 1915, U.S. Public Health Service, p. 65.)

BERIBERI.

Beriberi in Lebong.

At page 539 of Vol. 6 of this *Bulletin* [Sanitation Number], in connection with the etiology of beriberi, the writer suggested that it is not yet clear that those who hold other than the vitamine theory of origin are not dealing with forms of polyneuritis due to other causes, and so far not clinically distinguished from classical beriberi. FRASER and STANTON called attention to this aspect of the subject at the British Medical Association meeting of 1914.

Hence, in the Note referred to, opinions of those supporting the insect-borne theory of the disease were grouped together. In previous Notes* will also be found opinions which would connect beriberi with food articles—more especially rice—which have been subjected to moulds or to conditions favouring the influence of damp†; and it was suggested that, as far as the important sub-pericarpal layers are concerned, destruction by moulds might be as inimical as by milling, and the possibility that other changes in grain which has been subjected to prolonged damp may occur, deserves notice.

* Sanitation Nos. of this *Bulletin*, Vol. 5. pp. 167, 461; and Vol. 4. p. 214.

† A practical way of testing this theory would be to ascertain the vitamine contents of rice of the same stock preserved normally and subjected to influence of *prolonged* damp and moulds, respectively: or by careful feeding experiments. Indian customs recognize changes in the constituents of rice grain with advance of time after reaping.

In this connection, the epidemic of beriberi of 1913 amongst British troops at Lebong, where the medical officer in charge favoured the insect-borne theory, is of interest. The Committee, whose names appear in the Note above referred to, concluded definitely that the disease was beriberi, and that the "food of the troops could only be described as dangerously lacking in vitamine content."

An abstract of the Report on this subject by Major KENNEDY, R.A.M.C., is given in the *Journal of the Royal Army Medical Corps* for September 1915.

The conditions found at Lebong, coupled with the success described as attending the issue of a revised diet, are liable to be accepted, unreservedly, as a further proof of the vitamine theory of beriberi. Yet, on the above grounds, whilst in no way deprecating the value of the enquiry, the writer would suggest that in certain aspects it was incomplete, and that certain of its conclusions are "not proven."

The pros and cons of the subject may be conveniently considered in the order followed by Major Kennedy :—

History of the Disease.—Major Kennedy states :—"No record of a similar disease having occurred in Lebong prior to 1911 could be found." The Committee however asserted "that they considered that this disease had existed in the garrison at Lebong for some years but that the cases were of a mild type and difficult to be recognized."* (1) It is also on official record asserted that "successive outbursts of the disease had occurred in different Infantry units stationed there (Lebong) in recent years."

Climate and Climatic Diseases.—Whilst these factors *plus* dietary are claimed as predisposing causes of beriberi, there is nothing to show how it happens that (2) "the troops at Jalapahar a mile or two away never suffered from beriberi." The Report asserts that of the King's Own Regiment 65 men contracted the disease at Lebong and 9 at Barrackpore,† but it is not attempted to show that in climate, climatic disease and the demands for exercise requirement, Lebong and Barrackpore differ from Jalapahar.

Dietary.—Against the Committee's assertion as to the food lacking vitamine content is the plain fact that "there was no apparent (3) difference between the rations the Lebong garrison received and those issued to other soldiers throughout India including Jalapahar." Major Kennedy however holds that "the meat at Lebong was deficient in fat, tough, and had an excess of bone. There is no doubt that the vitamine value of such meat must be low. Fresh milk and eggs were almost lacking," and the men, in spending their extra messing allowance "did not seem to select oatmeal, peas and barley. . . . The Government ration includes 2 oz. of flour, but these articles were not fully used." Now this is the sum of the suspicion of the diet "lacking dangerously vitamine content." Putting aside the absence of isolation of the elusive "vitamine," it surely was incumbent to show where the dietary, as served to the British troops, approached that of Barrackpore, and differed from that at Jalapahar and other parts of India. The only reason given for asserting lack of vitamine value as to the meat is that it was due to prolonged driving of animals (followed by a

* (1), (2), (3) Report of the Sanitary Commissioner with the Government of India for 1913, p. 17 *et seq.*

†In 1913 there were 19 cases at Barrackpore.

fortnight's rest) prior to slaughter, and lack of good pasturage. But, allowing that Commissariat officers exercise discretion in requiring diligent search on the part of contractors, there is no evidence to show that the meat for troops gathered from famine areas (of which there has been no lack of instances) elsewhere in India has at any time disposed to beriberi. As to eggs and milk, it should not be difficult to show that amongst British troops there are plenty of men who habitually exclude such articles from their "extras," without contracting beriberi. It should also have been possible for Major Kennedy to have reported from the canteen and "coffee shop" records what extras the average soldier tends towards, and if they also were dangerously lacking in vitamine; whilst if the men's "predilection" at Lebong was not for such desirable articles as "oatmeal, peas, lentils or barley," it was necessary to prove that elsewhere, on the same Government ration, such articles were usually bought by the men.

Major Kennedy gives a statement of the nature of dietary under the original regimental arrangements and that as secured by him at increased cost, as follows:—

"E" Company, from July 1st to July 7th, 1913.

Breakfast	Cheese and onions.	Meat and salad.	Bacon and tomatoes.	Steak and onions.	Bacon and onions.	Butter.	Cheese and onions.
Soup ..	..	..	..	..	..	..	..
Meat ..	Roast	Stew	Roast	Roast	Stew	Roast	Stew
Pudding	..	..	..	..	..	Stewed peaches	..
Tea ..	Tea and bread; no extras.						

"A" Company, from August 2nd to August 8th, 1914.

Breakfast	Cold pork and sauce.	Porridge and butter.	Steak and onions.	Bacon and onions.	Eggs and butter.	Porridge and cutlet.	Butter.
Soup ..	..	Dhal	..	Dhal	..	Barley	..
Meat ..	Roast	Hotpot	Brown stew	Roast	Irish stew	Potato pie	Irish stew
Pudding	Currant	..	Rice	..	Treacle	..	..
Tea ..	Potato cutlets	Eggs and butter	Sausage tomato	Cold meat and salad	Potato pie	Butter	Meat rissoles

Of the improvement thus secured of variety of cooking, but not necessarily of either weight or variety of material, in fact, there can be no doubt; but, in judging of this, the appalling entry in the old scale for tea—"tea and bread, no extras"—is discounted by the fact that it does not follow "no extras" were purchased by the

troops under the old arrangements, when expenditure in extras was voluntary. This possibility should have been verified by the canteen and coffee shop accounts. Ultimately a very special scale of dietary was sanctioned by the Government of India for Lebong, *but too late to influence in any way the troops originally infected with beriberi.*

Loss of Weight.—No weightment tests were available prior to the period of duty by Major Kennedy, and he points to the importance of loss of weight as a prodromal of beriberi. Weightments were instituted by him, but he concluded that "in spite of the improvement of the dietary of the Regiment, there was a general loss of weight during the year." He has not "the least hesitation in attributing this to the climate, in other words to the rainfall." This conclusion is emphasized by pointing to the fact that whilst rainfall is registered from towards the end of April to end of September there is none during October. Therefore, using Major Kennedy's assertion as to decreasing weightments being prodromal of beriberi, the men during the months prior to October were, in spite of improved dietary, proceeding towards exhibition of that disease, and rainfall (increased air moisture) in spite of improved dietary, was the determining factor.

Physical Training and Exercises.—The severity of methods pursued Major Kennedy considers were, having regard to altitude, more than was desirable in the interests of general health of the men, and, under his advice, they were reduced. In support, he states that three of the four cases of beriberi, during 1914, occurred in A Company occupying bungalows 18 and 21, and that B Company had no cases, although "the two companies lived side by side in the group of four bungalows at the lowest and remotest part of the cantonment and had practically the same food." This contrast Major Kennedy considers is accounted for by the fact that physical strain on A Company was greater than B Company, in that whilst in August B had rest A Company carried on company training.

But this possibility in one case should not be allowed to overshadow the important facts that Company A lived in bungalows which in 1913 had afforded 28 out of a total of 65 cases, nor that the physical training and company training in the case of E and H Companies followed each other within the rainy season as in the case of A Company; and, further, that E and H Companies were neither affected in 1913 nor 1914.

Such facts should have tended to concentrate special attention on conditions affecting the inhabitants and the environment of bungalows twice previously exhibiting infection.

Diarrhoea.—The cases of epidemic diarrhoea amongst the men would be at once granted (side by side with excessive physical strain if proved) as favouring decrease of resistance to any form of disease, and would be of special importance when a "diet-deficiency disease" is concerned. Hence Major Kennedy rightly places weight upon this factor. Indeed, the writer suggests it might fairly be held that diarrhoea would, in the presence of a diet-deficiency disease, be a more inimical factor than Company training—carried out under the care of technically qualified combatant officers. If this be granted, it is worth remembering that whilst Company B living in the same area and under the same condition of food as A Company (strength not stated in either case) had in July 11 cases of diarrhoea, A Company had 12. An analysis of the dates of occurrence shows that the initial symptoms of beriberi had more

reference to July than to August when B had the supposed benefit of rest. Hence, the contrast between Company A producing three cases of beriberi as against none in B becomes more striking.

Accommodation and Hygienic Conditions.—In the light of the above facts, any matter pointing to a connection between the occurrence of beriberi and particular quarters should be of special value. Thus, it is found that the men inhabiting the following bungalows were not subject to beriberi either in 1913 or 1914 :—Numbers 1, 6, 7, 8, and 15. Major Kennedy states : " I have already referred to the fact that the six bungalows, numbers 16 to 21, with a nominal accommodation of 338 out of a total of 890, provided 30 out of 60 cases in 1913, and 3 out of 4 in 1914." Now this is a most important statement when placed side by side with the fact that of the total of 21 bungalows five in neither year yielded a single case, and that the four cases that did occur in 1914 were solely in bungalows which previously yielded cases. Major Kennedy attempts a " partial explanation " by referring to extra strain on the men in the bungalows 16 to 21, and illustrates his theory thus :— " A man living in number 20 has to go three quarters of a mile (reckoned on the level) and climb a height of 425 feet. He probably does this before breakfast and at least once between breakfast and dinner. Then again the canteen and coffee shop are 730 yards distant and 375 feet higher up." This method of stating the data available is however liable to misinterpretation. The term " 375 feet higher up " might imply 375+425 feet which is inconsistent with the measurements afforded in the plan which accompanies the text, whilst as the canteen and coffee shop are at the same level as the parade ground, there is no reason why one of the two journeys to and from parade should not also include the visit to the canteen and coffee shop. Be this as it may, the difference in level between bungalow 20 (5,575 feet) and parade ground (5,970 feet) is 395 (not 425). But it is necessary not to fix attention on the facts solely as to bungalow number 20, but to ascertain what was really the *excess* height in the daily task of the beriberi subjects compared with those not so afflicted.

Now the bungalows numbered 14 and 15 get no special notice in the Report. Yet men from number 14 proceeding to the parade ground fulfilled 180 feet ascent and for the canteen 130 feet., whereas men from number 15 fulfilled 250 feet to the parade ground, and 200 to the canteen. Hence, if the ascent were the determining factor of beriberi, men of number 15 bungalow should have suffered more than those of number 14. Moreover, in the case of bungalow number 20 as against bungalow number 15, the comparative excess daily task was walking (presumably at leisure) and lifting the body through 195 feet. Major Kennedy's data however show that neither in 1913 nor 1914 were men inhabiting number 15 infected, whereas there were nine cases in 1913 in number 14 against an average of two in the bungalows other than 16 to 21, noted by Major Kennedy as specially affected.

If, then, this extra task of ascent does not seem the determining factor, there is at least one peculiarity shared alike by the bungalows chiefly yielding beriberi cases that cannot be ignored, and which is thus stated by Major Kennedy :—

" The bungalows on the western slope suffer most from this disability and are also more exposed to the prevailing damp winds. The dampness

of these bungalows was clearly demonstrated when I took up the flooring of one of the rooms (4 Bungalow 20). The majority of the men in this room were suffering from some ailment such as sore throat or diarrhœa, and complained of a smell. The earth underneath the flooring was damp and mouldy, and the musty odour was simply overpowering. The investigation resulted in my contracting a severe sore throat. . . . It is interesting to note that two of the bungalows (Nos. 6 and 7) *already have concrete basements and that no case of beriberi occurred in either of them in* 1913." [Italics not in original.]

Research.—Major Kennedy failed to segregate any special organism from two human subjects post mortem, or to transmit the disease by inoculation of material to monkeys. He mentions the interesting fact that " dogs at Lebong suffer from a curious disease . . . the symptoms being fever, pains in the back and limbs, weakness of the legs and partial paralysis and loss of weight."

Note.—It would seem that whatever the ground for suspicion, there is no proof that the food of the troops was " dangerously lacking in vitamine " ; improved resistance to the causative agent of beriberi probably was brought about by improved diet and decreased physical exercise ; attention to the possibility of other than the vitamine theory of beriberi being applicable to the outbreak was not sufficiently met by the inoculation experiments, in that the material being derived from two old cases the organism of origin might have been absent, although results of its toxin in tissues might exist ; notwithstanding the opinion of medical officers concerned prior to appointment of the Committee, no search was made for the presence of insects such as bugs and fleas, and no statement is made as to whether the officers responsible for the insect-borne theory had carried out any campaign against insects prior to the dietary changes, which may have modified results in 1914 ; having regard to incidence in 1914 of beriberi solely in bungalows infected in 1913, notwithstanding change of diet, neither " place " nor the insect-borne hypothesis are excluded, whilst, in view of the frequently reported occurrence of *beriberi in damp climates by observers elsewhere, and the existence of moulds in habitations and in food articles*, the conditions described in bungalow 20 and the connection between general health and rainfall (vide para. " Loss of weight " *supra*) were so marked as to have demanded special experimental enquiry, without which the investigation was incomplete ; the Report is also incomplete in that no note is made of food conditions at Jalapahar and Barrackpore nor indeed in India at large, in the face of similar and definite rations being allowed British soldiers wherever stationed.

Beriberi in the Malay States.

Drs. Fraser and Stanton have not been content with putting on record their views as to the importance of the subpericarpal layers in rice in the etiology of beriberi ; they have put to the test the opposing insect-borne and place-disease theories. An interesting summary of their observations is given in the Annual Report of the Institute of Medical Research, Kuala Lumpur, for 1914. Drs. Fraser and Stanton have assumed no dogmatic attitude in the matter. They grant, as also conceded by Lovelace of Brazil, that elsewhere forms of polyneuritis may occur which are clinically capable of being classed as

beriberi, and which future investigations may prove to be due to causes other than dietetic; but state that, so far as the disease as witnessed by them in the Malay State is concerned, it is strictly connected with an error of preparation of the rice in the case of those using rice as the staple grain. This may be more or less the issuing a challenge to those supporting other theories, but it is at least eminently fair.

Against the insect-borne theory in the Malay States, the Report gives instances of persons affected with beriberi on polished rice diet being purposely mingled with the healthy subsisting on unpolished rice; so that all possible opportunities were afforded of bugs, fleas, or lice being transferred with personal property and even with residences. The result is thus stated [p. 3]:—

"Within one month there occurred in the polished rice party five further cases of beriberi, while no sign of the disease appeared in any member of the unpolished rice party."

Without attempting to throw doubt upon the direct connection between the absence of the sub-pericarpal layers of rice and beriberi, it is possible for objectors to hold that, as the prodromal period of beriberi is about three months, a more prolonged period of observation was desirable, and that the proportion of cases actually suffering from beriberi introduced into the healthy group is not stated; and, further, that if air moisture be a favouring condition of the causative agent a statement of the particular month during which experiments were conducted was desirable. In this connection, it is worth remembering that in an epidemic in the Thayetmyo Jail, Burma, in 1882, which was then bug infested, the Burmans resident together in special wards were infected, whilst Indians in separate wards remained free although the same diet was used. In this jail an enormous and mouldy mound of husk of the unpolished rice used was a remarkable sanitary coincidence.

Apparently, in the experiments of transfer of property, the presence of ecto-parasites was assumed, and it would certainly in practice, in any case, be a mere question of the proportion of parasites in relation to time and opportunity; so that to this extent the experiment is incomplete, although in other respects convincing. This is to be borne in mind, as qualifying the criticism in the Report of the advocacy of Stanley, Davis and Arnold of the insect-borne theory. The following is Dr. Fraser's statement on the subject [p. 4]:—

"The evidence which Dr. Stanley has obtained in regard to the Shanghai Gaol is briefly as follows: The number of cases of beriberi since 1899 has been: Old Gaol, 1889, 27; 1900, 34; 1901, 134; (*modified diet introduced*) 1902, 0; (*prisoners transferred to New Gaol*) 1903, 0; 1904, 2; 1905, 2; 1906, 2; 1907, 1; 1908, 5; 1909, 78; (*recommendations as to destruction of vermin introduced*) 1910, 16; 1911, 7; 1912, 2.

"The modification in diet recommended in 1901 was followed by a fall in the number of cases from 134 to 0, other conditions remaining the same; the recommendations regarding the disinfestation of vermin of 1909 were followed by a fall in the number of cases from 78 to 16."

In favour of the vitamine theory, the fall from 134 in 1901 to 0 in 1902 is striking, but also is the increasing incidence from 1903 to 1909 significant of possible infection of the new jail, accompanied as it was by a period of special destruction of vermin. The inevitable policy, in the presence of manifest room for further investigation, is "wait and see."

Vaccination.

Inspection of Vaccination Results in Rural Areas.

The Annual Vaccination Report for the Punjab 1914–15 (p. 3) shows that the pronouncement of successful vaccination depends considerably upon the personal equation of inspecting agencies. For primary vaccination Civil Surgeons, Divisional Inspectors, Superintendents of Vaccination and Vaccinators reported the following success rates, respectively :—93·61, 94·65, 95·66 and 97·13. The hopeful character of the Vaccinators' results are sufficiently remarkable, when contrasted with the findings of other agencies, to suggest a want of rigidity in arriving at a judgment. On the other hand, the results of verification by Inspecting Officers is liable to differ in accordance with their ability to circumvent an artful vaccinator.

In working rural areas the Inspecting Officer has a rough time before him, and an intelligent vaccinator is prepared to make matters easy by securing the assembly of children at a certain spot except those unfortunately absent in the fields or on visits to their relations which, being interpreted, may mean the majority of the unsuccessful cases. To overcome this difficulty, the toilsome method of house-to-house inspection, or a sudden morning descent upon a village, will occasionally aid in obtaining the bare truth.

But the Madras Presidency has for some years adopted methods under what is known as the " trial scheme "* which relieves vaccination statistics of the ideal figures rendered by the too optimistic vaccinator.

Both vaccination and registration of Vital Statistics are compulsory in the rural areas concerned. The Village Officials, according to pre-arranged programmes, are bound to produce all unvaccinated infants in their village before the vaccinator on a certain date. The operations having been performed by well-educated and trained vaccinators, the results are left for inspection by Deputy Inspectors of Vaccination, who also work in accordance with a pre-arranged programme, and inspect immediately behind their vaccinators, so as to arrive at each village concerned within the days of vesiculation. This system secures much economy of staff and in verification leaves nothing to the imagination of vaccinators. It is to be understood that none but preserved animal vaccine is employed and that consequently, a return of the vaccinator to ascertain nature of vesiculation or to secure a stock of lymph is not necessary.

Cultivation of Animal Vaccine.

The successful cultivation of animal vaccine under tropical conditions on a large scale cannot be conducted by rule of thumb methods. There are difficulties to be met as to temperature, air, moisture, breeds of cattle, means of feeding, etc., in endless variety ; but these having been overcome, there is forced upon the operator the plain fact that there are conditions daily met with which cannot be explained by present day knowledge. These are closely allied with

* Because it was first employed experimentally in specified districts.

the problem of immunity, and afford, somewhat tantalizing, if interesting items for investigation. To get rid of some of the doubtful factors has been attempted on a systematic scale by Lt.-Col. Gibson, I.M.S., Director of the King Institute, Madras.

The Vigour of Vaccine.—Experiments were conducted with the object of securing a robust seed lymph, by checking the growth of extraneous micro-organisms in lanoline vaccine. He states :—

" Glycerine of course does this ; but at Indian temperatures it is also very injurious to the vaccine. Desiccation was tried, the vaccine being first incorporated with five times its weight of milk sugar. The idea was to render the dried vaccine more readily soluble as well as to dilute it. A material was got which produced good but somewhat delayed vesication on calves. It did not however show any great keeping qualities and as its manipulation was definitely more complicated than that of lanoline vaccine this attempt was abandoned. Further experiments are in progress."

The Yield of Vaccine Pulp.—Major Patton, I.M.S., Assistant Director, as stated in this *Bulletin* [Sanitation Number, p. 167, Vol. 5, No. 3, 1915] considered that by subjecting vaccine pulp unmixed to the action of cold, a change was produced which brought about increased bulk of vesicle pulp on this being used for seed lymph. Experiments made by Lt.-Col. Gibson to verify this produced unsatisfactory results, as to success rates, when compared with those obtained with stored standard lanoline vaccine. At the same time he reports that " the yield per calf was certainly larger than in the previous year."

Variability of Results on Individual Calves.—On this subject the following extracts from the original Report* are quoted :—

" From a certain date every calf admitted into the Institute was classified under the following headings :—Admission number, Serial number, Sex, Size, Colouration of skin, Texture of skin, and Surface feel of skin. On vaccination and pulping, the period, quality and appearance of the lines together with the yield per calf were noted in corresponding columns. Over 500 calves were so examined. The texture of the skin being considered as probably the most important, the average yield per animal was calculated in the following groups :—

" Thin and soft skin—that is having little subcutaneous tissue but the actual skin of loose texture.

" Thin and hard—having little subcutaneous tissue but the skin of dense firm texture.

" Thick and soft—Thick and hard—having subcutaneous tissue and with the actual skin of loose and dense texture, respectively. . . .

" Further analyses were made with regard to the varying points of the animals, but in these it was endeavoured to test the virtue or the reverse of any particular point by its effect on the percentage of animals showing :—

" (1) Specially good vesiculation (that is selected for seed lymph). Quality good.

" (2) Total failure of vesiculation.

" (3) Yield more than three grammes above the average, *i.e.* good quantity.

" (4) Yield more than three grammes below the average.

*Annual Report on Vaccination in the Madras Presidency and on the work of the Vaccine Section, King Institute of Preventive Medicine, Madras. 1914–1915.

"Table XIV. gives these results :—

TABLE XIV.

		Specially good quality.	Failure.	Specially good quantity.	Yield small.
		Per cent.	Per cent.	Per cent.	Per cent.
	Cow	5·4	5·0	13·0	4·2
	Bull	7·7	7·7	3·85	0·0
	Large	4·5	5·7	17·0	3·4
	Medium	5·3	4·1	12·0	4·4
	Small	10·7	18·0	7·1	0·0
Skin colour.	White	7·7	3·8	11·5	3·8
	Tinted	6·2	3·6	10·8	3·6
	Pale pigment ..	5·2	5·6	12·45	4·4
	Dark pigment ..	3·6	9·0	18·2	3·6
Skin surface.	Smooth	8·6	6·45	6·45	5·4
	Slightly rough ..	5·1	4·36	13·3	3·6
	Harsh	1·9	7·7	15·4	3·8

"The number of bulls was so small, only 26, that much weight cannot be laid on the results got with them, and therefore a sex comparison cannot be made.

"In the other groups however there appear to be fairly well defined relations, and for convenience of reference the various groups of figures have been bracketted in contrast to one another. A consideration of the table as a whole shows that the characters, which yield a specially good quality of lymph, are different and sometimes sharply contrasted to those which yield a good quantity.

"(*a*) Size of animal, where good quality is concerned. Here we see that small animals are better than large, but where a large quantity is concerned the larger the animal the better.

"(*b*) Size of animal in relation to failure. Here an exceptionally large percentage of small animals are found. Probably these were badly nourished animals, and the large number has something to do with an absence of small animals in the heading "small yield."

"(*c*) The figures for pigmentation are very instructive. In relation to good quality and failure they are sharply contrasted and also in relation to good quality and good quantity.

"(*d*) The same strong contrasts are shown when the surface of the skin is considered. Smooth skins give good quality but small quantity; harsh skins poor quality and large quantity.

"A further analysis of the table would probably yield other results and as time permits this will be carried out.

"Where any selection on purchase is for practical reasons impossible, the points elucidated may enable us to ensure a steady supply of lymph of fair quality."

FOOD.

The Grading of Milk.

There is increasing insistence by Sanitary Officers as to milk purity; but there are so many factors to be taken into account beyond the single dictum that the milk must be pure, that the methods advised by them for securing protection, necessarily, differ largely. In the first place, there is the plain fact that the public, whose safety is concerned, is rarely dissatisfied with milk whose richness is more apparent

at the bottom than at the top of a white fluid, more especially if they are required to pay an enhanced price for a less artificial product. In the next place, the possessor of cows fails to see why he should be required to expend money in supplying the animals with luxurious byres, and worry about the cleanliness of the milker's hands, if he be not allowed to increase the cost of milk. Thus, a spirit of compromise is liable to undermine the sanitarian's dictum, and a variety of standards have been evolved.

The President (J. F. Anderson), American Health Association, has recently* insisted upon the importance of milk being graded, so that the public shall have the opportunity of buying milk that is possibly impure or, for a better price, obtaining a safe supply. He puts this argument in a forcible manner :—

"It has always been one of the things which the writer could never understand why the idea seems so deeply rooted in many of those who have to do with the milk industry—producers, inspectors, and consumers—that the farmer or the dealer who sells a clean milk, and therefore a safe milk, should not receive a higher price than his neighbour receives for a dirty, unsafe milk. The establishment of grades and standards for milk will cause this idea to disappear."

He objected absolutely to the principle of "one quality—one price of milk."

There are endless arguments that could be brought to bear both for the pros and the cons of the contentions thus made. Probably, to most persons, instead of these two compromises with purity, a third would appeal : a minimum standard purity, and a graded excellence at enhanced rates. On the other hand, at least one large city (Rangoon) has met the demand for inferior quality half-way by legalising the selling of "watered milk."

Grading milk, if conscientiously carried out, demands a consideration of numerous factors. A method for estimating their influence has been elaborated by W. C. Woodward, Health Officer, District of Columbia. As advocated and carried out by means of a large staff of Inspectors, the personal equation in judging is largely eliminated, and thus a possible objection is capable of being met. Without entering into details, it will be seen from the following quotation that he has worked out a system which is fair both to the consumer and producer :—

"100 points are allowed for the dairy farm, both equipment and management ; 100 points are allowed for the cattle ; 100 points are allowed for the milk distributing station, if the milk is not distributed directly from the farm ; 100 points are allowed for the bacteriological examination. The total number of possible points is 600 if there be a milk-distributing station, and 500 if there be no such station. By dividing the total number of points allowed by the total number of points possible a figure is obtained in the form of a decimal fraction representing the grade of the milk. Any unusual conditions bearing upon the nutritive quality of the milk or on its wholesomeness, but not susceptible of being reduced to a percentage basis, are to be set forth in an explanatory note, if the grade is computed during the continuance of such conditions ; such, for instance, as a milk-borne outbreak of typhoid fever or other contagious disease."

*U.S. Public Health Reports. 1916. Jan. 7. Vol. 31. No. 1. p. 5.

But figures so obtained could not apply to a milk which is the mixed product of several farms. He illustrates the method of dealing with this condition as follows :—

"The method may best be understood by a simple illustration. Producers A, B, and C all send their milk to Dairy No. 342. A has 100 cows, scored 100. B has 50 cows, scored 80. C has 10 cows, scored 40. To determine the rating to be allowed for the cattle in computing the final score :—

Producer.				
A	(number of cattle) 100	(multiplied by score)	100 =	10,000
B	(number of cattle) 50	(multiplied by score)	80 =	4,000
C	(number of cattle) 10	(multiplied by score)	40 =	400
	160			14,400

Dividing the sum of the multiplied score, 14,400, by the total number of cattle, 160, the quotient is 90, the rating to be allowed for the cattle in determining the grade of milk distributed by the common distributing agency, Dairy No. 342."

An ancient Hindu method of grading milk was recently represented to the Calcutta Corporation by the Bengal Landholders' Association, as suitable for adoption in making a standard for milk in that city. It is apparently based on a liberal allowance for the total solids of milk in the form of curds, and would, at least in the absence of the more simple method of employing the lactometer of the present day, indicate adulteration by water ; but the method is at least of interest as an early effort towards "grading" milk. Under this system, a contract for first service (secured by means of monetary advances) was made by sweetmeat makers with milkmen, and they paid according to the following standard :—

"Each seer (2 pints) of milk must yield ¼ seer of curds. For milk reaching this standard the sweetmeat maker paid a rupee for 16 seers, but if, for example, the proportion was four seers of curds in 20 seers of milk the payment would be for 16 seers of milk only."

A Milk Standard for India.

This subject has had much attention at the hands of Dr. Lemuel Lucas Joshi, Analyst to the City of Bombay Corporation. The work undertaken by him to arrive at his conclusion must have been of a most arduous nature. He found that the quality of milk differs materially with the breed of animals, so that whilst the standard suggested by him is correct for Bombay and Western India, he considers it would be desirable for legal purposes, were the various areas of the country to form local milk standards. As a result of analysis of

500 specimens of milk, he gives the following composition of buffalo and cows' milk, respectively* :—

	No. of animals examined.	Total Solids per cent.	Fat per cent.	Non-fatty Solids per cent.	Specific Gravity at 60° F.
1. Buffaloes' Milk :—					
Series I. ..	271	17·11	7·62	9·57	1,028·8
,, II. ..	205	17·40	7·87	9·53	1,030
2. Cows' Milk..	50	14·89	5·79	9·10	1,029

From these analyses, he would deduce the following standards :—

Proposed Milk Standard (Chemical), for Bombay and Western India.

	Fat per cent.		Non-fatty Solids per cent.	
	Average.	Lowest legal limit.	Average.	Lowest legal limit.
Buffaloes' Milk ..	6·5 to 7·5	5	9 to 9·5	8·5
Cows' Milk ..	4 to 5	3·5	8·5 to 9	8·0

As to bacterial standards, he gives the following opinion :—

"As regards *Bacterial Standards for milk*, it may not be considered desirable at present to adopt them for *legal* purposes but undoubtedly they would be very useful as guides for *administrative* purposes. Besides, the present bacteriological investigation is probably the *first* one of its kind in India and further research would be necessary in other parts of India before a definite standard can be arrived at. In the meantime in the light of the results already obtained in Bombay the following *Bacterial standard for Bombay Milk* is suggested as a provisional measure :—

"(*a*) *Microbes per cc.* : These should not exceed two millions in the cold weather (November to March), and five millions during the hot and rainy seasons (April to October); (*b*) *Lactose Fermenters* : They should be absent in a dilution of 1 : 100 in the cold season and 1 : 1000 during the other seasons ; (*c*) *Microscopic examination of the sediment* should show only a few leucocytes and perhaps a few cocci and bacilli, but pus cells and (pathogenic) streptococci should be always absent ; (*d*) *pathogenic microbes, e.g.*, Tubercle Bacilli, Cholera vibrio, B. Typhosus, etc., should be always absent.

"The comparatively favourable bacterial results obtained in samples of milk, which were pasteurised and then kept constantly at a temperature under 50° F., demonstrate the advantages of pasteurised milk over raw milk."

*Administration Report of the Municipal Commissioner for the City of Bombay for the Year 1914–15. Vol. II. Annual Report of the Executive Health Officer for 1914. p. 124.

Vitamines.

It is a much easier matter to assert that such and such a food substance lacks vitamine than to demonstrate a vitamine when present. In the Hygienic Laboratory, U.S. Public Health Service* the subject has been investigated in a practical manner by Atherton SEIDELL, Technical Assistant. He conceived that yeast might be likely to yield a readily demonstrable amount. Of this, from a brewery, he was able to obtain large amounts of material that was regarded as waste. This was subjected to hydraulic pressure, so as to remove traces of beer. It was then washed with water and again pressed. The cake thus made was

"placed in enamel-ware vessels and brought to a temperature of 37·5° C. and held there for a period of about 48 hours. The autolysis is more or less complete at the end of this time and the material converted to the consistency of thick soup." This is then filtered, and if the filtrate be "administered in 1 cc. doses on alternate days to a pigeon kept on an exclusive diet of polished rice, the pigeon does not lose weight nor show symptoms within at least two months, the period during which the present experiment has been under way. A pigeon kept on polished rice without the yeast filtrate begins to lose weight usually within the first five days and dies with the typical paralysis of polyneuritis within about 20 days. If 1 cc. of the yeast filtrate is given to completely paralyzed pigeons a relief of the paralysis will occur within an hour and to all outward appearances the pigeon will be restored to a normal condition within 12 hours."

This preparation therefore contained the active vitamine, but as from comparison with the weight of a pigeon 200 cc. would be required for a man, concentration was evidently desirable. This he has accomplished by using the selective powers of a special preparation of hydrous aluminium silicate, as used by Professor LLOYD for separation of alkaloids. Having proved by experiments in pigeons the presence of vitamines, Seidell next attempted to secure an activated solid. This he managed by adding 50 gram per litre of LLOYD's colloidal hydrous aluminium silicate to a large volume of clear autolyzed yeast filtrate. This is well shaken and allowed to deposit, aided by a small amount of hydrochloric acid. The recovered solid is well washed and dried in vacuum desiccators.

"Both preventive and curative experiments on pigeons have been made with this material, and the results agree with those already described and illustrated . . . for the product made with the ratio of 200 grams of reagent per litre of yeast filtrate. It has been found that prompt and effective cures of completely paralyzed pigeons result from 0·05 gram doses of the activated solid, corresponding to 1 cc. of the original yeast filtrate. Preventive experiments, continued at present for over a month, using 0·05 gram of the solid on alternate days, show that the pigeon retains its normal health and weight on an exclusive diet of polished rice."

These experiments mark a decided advance in both preventive and curative measures against food deficiency diseases.

Vitamines and Pellagra.

This subject is discussed in a communication to the *U.S. Public Health Reports* of April 14th, 1916.† The authors refer to the com-

*U.S. Public Health Reports. 1916. Feb. 18. Vol. 31. No. 7. p. 365.

†By Carl VOEGTLIN, Professor of Pharmacology, M. X. SULLIVAN, Biochemist, and C. N. MYERS, Technical Assistant, U.S.A. Public Health Service.

position of highly milled wheat and corn flour as contrasted with the stone milled products of former days. They place no stress on the different chemical composition of such flour, beyond saying that they "contain less protein, fat, and ash" than the old fashioned products, but hold that a perfect analogy exists

"between the well-known relation of the polishing of rice to its nutritive value, and the milling of wheat and corn to the nutritive value of wheat flour and corn meal. In the case of beriberi, numerous observations have demonstrated the fact that, if the diet of people is largely made up of highly polished rice and is otherwise deficient in vitamines, beriberi will make its appearance, whereas, if undermilled rice is substituted for the highly milled variety, the disease is not so likely to break out. Little reports an outbreak of beriberi among the fishermen of Newfoundland, who lived mainly on bread made from highly milled wheat flour."

They grant the difficulty of isolating the vitamines in wheat and maize flour, but hold FRASER and STANTON'S method of using the phosphorous content to be a sufficient indication.

They suggest for maize flour that "the P_2O_5 contents should not be less than 0·50 per cent." The test is unsuitable for "self-raising" flour, as it contains a baking powder composed of phosphates.

Holding that the experiments of SULLIVAN and VOEGTLIN have established that alkalies have a destructive action on vitamines (especially conjoined with high temperature) they point to the fact that the present day highly milled flour products are liable to further alteration as to vitamine contents in the process of cooking bread. Formerly, it was the custom to use sour milk and soda for production of CO_2 during baking; but the present tendency is to do without the sour milk, and hence the alkali is not neutralized but remains to destroy the vitamines.

Of the influence of these facts, they give experimental proof conducted on fowls. They find "that corn bread prepared by means of baking soda without the addition of buttermilk is deficient in certain essentials, accessory foods (vitamines) and that this deficiency is due to the destructive action of the alkali (baking soda) on the vitamines which were originally contained in these foods."

On this basis, they direct attention to the occurrence of pellagra following changed economic conditions of populations in certain parts of the United States. They state that

"in Spartanburg County it is evident that a large proportion of the people, especially in mill villages, live on a diet which is deficient from the point of view of its vitamine content. Wheat biscuits made from highly milled wheat flour and corn bread made with baking soda without the addition of buttermilk are the staple articles of diet among the people, and we have found families in which these foods represented about three-fourths of the entire diet. The fact that the above-mentioned influences, which have undoubtedly reduced the vitamine content of the diet, made themselves felt a relatively short time before the rapid increase in the pellagra incidence in this section of the country, furnishes considerable evidence in favor of the vitamine-deficiency theory of pellagra. It will be left for future investigations to prove or disprove the correctness of this assumption for other pellagrous sections of the South. The reported results emphasize the fact that, in studying the etiology of any disease which is assumed to be of dietary origin, it is essential to pay careful attention to what might appear on superficial examination as trivial details."

The evidence these authors have furnished as to influence on dietary of a particular method of cooking bread is undoubtedly of importance,

and will aid future investigation in such points as duration of high temperature for cooking cereals, the use of added alkalis, and the nature of water employed ; but, if the vitamine theory is to fit into pellagra etiology—as it well may—there is a vast gap to be filled in between the polyneuritis of chickens and the particular variety of vitamine (of the possibly several forms) from the absence of which the pellagrous subject suffers. The bulk of populations in the famines of India have not suffered from acute but chronic starvation, extending over many months ; such populations should produce a reasonable number of cases of polyneuritis, beriberi, and pellagra, by reason of absence of vitamines. In the case of the great famine of 1876–1878 in the Madras Presidency, the only grain available in certain parts of the country was Burma *milled* rice. These diseases were not recognizable—a fact which, at least, points to the vastness of the whole subject and the importance of identification of vitamines as separate entities with individual functions, if the use of the term is not to become a convenient method of hiding professional ignorance, in accord with the "catalytic action" which did much service in the same cause in the seventies.

Water Purification.

*An experimental investigation of the value of chloride of lime in the sterilisation of water has been published by Ottolenghi. River water was used, to which measured quantities of typhoid and other bacilli of the coli group were added. It was found that effective sterilization takes place if an excess of not less than 2 to 3 milligrammes of free chlorine is present per litre, after the lapse of 15 minutes. The determination of the amount of free chlorine present is made by the addition to each litre of water of 1 decigramme of a powder containing three parts of starch to one of crystallised potassium iodide. The colour produced should be of a deep violet-blue, which should not diminish on standing. If the colour is only purple and begins shortly to fade, less than the requisite amount of free chlorine is present. The quantity of chloride of lime which will yield 15 milligrammes of permanently free chlorine may be taken as being 45 milligrammes, on the average, and this is the quantity which should be added, as a rule, to each litre of the water to be sterilized. It is a good thing to clarify very turbid waters, as a preliminary, by the addition of 15 to 20 milligrammes of sulphate of alumina per litre, or the sulphate of alumina may be added along with the chloride of lime, as they do not react on one another. The clear liquid is then decanted or filtered, and will be forthwith fit to use as drinking water.

*Ottolenghi (D.). Ricerche sperimentali sulla purificazione dell acqua per le truppe col cloruro di calce. [Experimental Researches on the Purification of Water for Troops by Means of Chloride of Lime.]—*Igiene Moderna,* 1916. Jan. Vol. 9. No. 1. 20 pp. [Summarised by J. B. Nias.]

SANITARY ORGANISATION.

Cause and Effect.

When the "Emden" fired a few shells into Madras city about 60,000 Indian inhabitants concluded this was but a foretaste of worse to come. They reckoned neither with the chivalrous conduct of the captain of the "Emden," in apparently attempting to confine himself to the devastation of petroleum tanks, nor with the fact that a "surprise" cannot well come off twice. The following result is recorded by the Health Officer* :—

"The 'Emden' bombarded the city on the 23rd September, and the exodus from the city has probably to account for the decline in the births. We may compare the records of the previous years :—

Births for October and November :

1911.	1912.	1913.	1914.
3,681.	3,963.	3,577.	2,588.

The decrease of over a thousand births may, therefore, be attributed to the bombardment."

But not only did the "Emden" decrease the birth-rate of this city, but it added greatly to the death-rate by cholera. The Health Officer asserts that when the exodus took place (23rd September) cholera was prevalent in the taluqs neighbouring the city, and when the refugees returned they brought cholera with them. This epidemic caused 2,332 attacks. Not solely to that very able Health Officer, Dr. Macdonald, but to the *amour propre* of his predecessors, it has always been apparent that Madras City is the innocent victim of the surrounding rural areas; and it is not surprising therefore that [p. 52] he puts the matter clearly before the reader :—

"With the city's dense population one would have expected the city to be a constant menace to the district, instead of the usual experience, the district being a danger to the city. The secret would seem to be in the fact that, imperfect as the city may be in many sanitary matters, it is yet much in advance of most moffusil villages. That may be regarded as an explanation of the city's danger from without."

Unfortunately, there is less evidence of the truth of this reasoning of cause and effect than in the case of the birth-rate and the "Emden's" shells. The portions of the following quotation from the Health Officer's Report [p. 52] which the writer has placed in italics show that the history is by no means so convincing as the argument used by the "Emden" :—

"Cholera was *officially* declared epidemic in the city in the week ending 15th August. *For some time previous to this date*, however, there *were scattered cases* returned from some divisions. When the city was *practically* free, cholera was raging in epidemic form in many parts of Chingleput District, the seizures at Conjeevaram being particularly heavy. But at an even earlier stage than then, cholera was in epidemic form in the villages near the Red Hill Lakes. *That was about the middle of July.* In August the usual Periapalayam Festival took place. Advertisements were inserted in the local press, warning intending pilgrims of the danger from cholera, and advising them not to attend. The usual annual precaution of patrolling the tollgates to check apparent cholera cases from entering the City, was in force during the whole Festival." [Italics not in original.]

*Report of the Health Officer, Corporation of Madras, Health Department for 1914. p. 41.

Granting, however, that the neighbouring district yielded to infection before the city, what did the Corporation do? The Health Officer reports that pilgrims were warned not to go to a certain festival and the tollgates were patrolled "to check apparent cases of cholera entering the city." But nothing is said as to action taken as to cholera "at an even earlier stage" being present "in epidemic form in the villages near the Red Hill Lakes." These lakes happen to be the impounding reservoirs of the Madras City water-supply. In 1882, a special Sanitary Officer [W. G. KING] was appointed by the Madras Government in reference to a cholera epidemic in the City of Madras. *Inter alia* he advised the removal of those villages, or other special sanitary methods, as an urgent necessity for Madras City. An estimate made at that time showed the cost involved would have been a really small total, but the municipality did not rise to the occasion. The matter was pressed in 1890, and in 1894 and 1905, by the same officer, as Sanitary Commissioner for Madras. By 1905, the value of the sites had risen ten times, showing that *early* action in protecting catchment areas is ordinarily in the direction of economy. The city of Madras should shortly have the protection of filtered water but, as the histories of Altona and the Lambeth Waterworks of London prove, something more than the existence of filters is necessary. Then, too, although the warning of pilgrims is worth the cash paid for advertisements, with 500,000 inhabitants at stake, it is more than likely the dreaded festival need not have contributed to the mortality of the city, had the Municipality and the District Board concerned pooled their resources and made combined efforts for an effective organisation. Cholera has never yet halted on one side of a toll-bar, in respect for the feelings of a corporation whose limits are conterminous with an infected district.

THE SANITARIAN AND FINANCE.

Dr. Malcolm WATSON concludes his interesting work "Rural Sanitation in the Tropics," reviewed in this number, with a reference to a sanitarian who in reply to a query "as to what was the cost of his proposal" stated: "When I give the order I don't bother about the cost." On this text, he cautions the sanitarian in the tropics that he must "cut his coat according to his cloth," and, using an extract from a Report on the "Economic conditions in Egypt," calls for pity for an administrator possessed for the first time of a surplus, and pestered by faddists oblivious of the total demands upon the public purse for railways, roads, bridges, increase of the army, education, hospitals, etc.

As to the case of the pseudo-sanitarian he cites, not only does he deserve the condemnation for contempt of finance which Dr. Malcolm Watson heaps upon him but, in the writer's opinion, still more so for the use of the word "order"; for nothing should be more clear in the sanitarian's mind than that (except in the case of subordinates placed at his disposal) he never *orders*—but advises. In any case, it is exceedingly unlikely that the sanitarian Dr. Malcolm Watson has called attention to is a type; at the utmost, he must be a freak with a distinct tendency to self-extinction. In the writer's opinion, the only point as to which an administrator deserves pity is that whilst the sanitarian's responsibility ends with advice, upon the former rests

the, at times, grave responsibility of action and, fortunately for the sanitarian, for the absence of action. It is by remembering these aspects of the matter, and in seeing that administrative and legal difficulties are duly allowed for in schemes he proposes that the sanitarian may best exhibit pity compatible with duty. The experienced administrator can always be relied upon to take care of the money bags and neither asks for nor deserves pity, and can ordinarily find a smile for the enthusiastic worker. If he be of the tactful variety, he may be depended upon to send all claimants away with the belief that if their particular fads cannot be satisfied in the present budget there are hopes that next year, etc., etc. "To cut the coat according to the cloth," as advised by Dr. Malcolm Watson, is of course a necessity, but it is still better that the sanitarian should attempt to get a reasonable amount of the total cloth. So long as heads of all spending Departments of Governments are sufficiently human to be inspired by the belief that, without the correct fulfilment of their particular function, the wheels of State cannot move smoothly, the sanitarian would be ill-advised not to make his voice heard in the crowd of applicants for funds, and that right lustily. He need not waste pity on the veteran administrator. On the opposite, he should stalk him systematically. For this purpose, he should acquire a fair knowledge of the total funds at disposal, and place his schemes for sanction in reasonably approximate detail as to cost, present and future—not forgetting possibilities of financial profit or saving. Further, his schemes should be launched in such manner and time as will prevent him receiving merely the crumbs from the financial table as an act of philanthropy—after all the other clamourers and faddists have been satisfied. It is worth remembering that, up to date, it is quite the exceptional administrator in the tropics who is capable of convincing himself that the improvement of health of a people (in the presence of successful government) results in an improvement of revenue. Sanitary matters are to the average official more allied to the Ecclesiastical Department of a State than that dealing with Industry and Commerce.

Night-soil Conservancy and Education.

The inimical influence of ankylostomiasis upon the physical labour powers of populations is well verified, but although it might be anticipated that the mental powers of infected persons as an accompaniment of anaemia and general debility should likewise be handicapped, such theory has not been put to the test. Writing in the *U.S. Public Health Reports*, 1915, July 9th, p. 2067, Professor C. W. Stiles shows from an examination of over 2,000 school children the extent to which these are infested with intestinal parasites, and, having ascertained the respective grades of educational efficiency, traces their sanitary history in respect to chances of faecal contamination following more or less imperfect conservancy of their homes. Homes where the privy system prevailed would certainly be more likely to offer chances of earth and fly-borne contamination than if sewered. Accordingly, he is able to quote figures proving that children in sewered homes advanced in education more rapidly than in those served by privies.

Whilst recognizing that other factors must come into consideration, he holds that

"it is, however, legitimate to invite attention to the fact that more cases of soil-pollution diseases are to be expected at privy homes (group P) than at sewered homes (group S), and therefore that more absence from school, with consequent retardation, because of these diseases, is to be expected among children from privy homes (group P) than among those from sewered homes (group S); the conclusion therefore seems justified that the privy, with its attendant dangers of disease, is one of the many factors involved in explaining the data submitted.

"If we study the cases of different intestinal parasitic infections that are spread through lack of proper disposal of human excreta, the conclusions seem justified that the cases of infection with *Endamoeba coli* and with *Lamblia* do not present any evidence that these two parasites have had any effect in the retardations noted; the statistics for infections with *Ascaris lumbricoides* and with *Necator americanus*, however, tend to support the view that these two parasites are factors that must be considered as of practical importance (less for *Ascaris* than for *Necator*) in connection with retardation, even in cases of relatively light infection, as were most of the cases with which we had to deal; our data for infection with *Trichomonas*, *Oxyuris*, *Trichuris*, and *Hymenolepis nana* are not sufficient to warrant any deduction as respects these parasites."

So common is infection with *Ascaris lumbricoides* and *Oxyuris vermicularis* of school children in the southern parts of India, the writer suggests that were Professor Stiles' method pursued, an excellent case would be made out for a policy which would demand not that education should precede hygiene but that it should accompany it. Putting aside the influence of these parasites upon general nutrition, so intensely does the nervous system of the oriental child respond to intestinal irritation that the physician who attempts to combat abnormal temperatures in fevers and ignores their presence, courts defeat.

SANITARY RULINGS.

Protection of Milk Purity in Four Indian Cities.

Calcutta.—In 1908–09, the Calcutta Municipality began to discuss seriously schemes for securing pure milk supplies for the city. The Health Officer of the period proposed Municipal Milk Depôts, the pasteurization and cooling of milk, model cow houses, municipal grazing and dairy farms. The discussion progressed excellently thereafter; but there is nothing to show that the milk supply has been improved in the interval. However, in the latter part of 1915, the question was referred to Captain Watson, I.A., Assistant Director of Military Dairy Farm. His advice, which has been accepted by the Corporation,* is thus recorded :—

" Briefly Captain Watson's recommendations are as follows :—(1) To obtain the necessary legal powers. (2) To establish markets in which all milk must be sold and where it will be subjected to proper examination. (3) To provide appliances for cleansing and pasteurising milk and to insist upon all milk sold being treated by this process. (4) To provide land at a distance from Calcutta to which the city *goalas* (milkmen) can go, and then take steps gradually to move them out of the city. (5) To arrange for the cheap transport of milk to Calcutta. (6) To establish a Municipal Dairy Farm as a model, and to assist and control the settlement of *goalas* in the country."

This advice of 1915 is sound; but so also was that by the Health Officer of 1908, on the same lines.

Bombay.—According to the Annual Report of the Executive Health Officer, Bombay, for 1913–14 [p. 44] several amendments and additions to Byelaws as to milch cattle stables have been secured, in the matter of supervision and control of premises, ventilation and cleanliness of stables and surrounding spaces, and precaution as to infectious diseases, and provision has been made for licensing milk sellers and places where milk is sold. Suggestions have also been made by Dr. Turner to secure that analysis for adulteration for milk shall be conducted by the Municipal Analyst; instead of by the Government Analyst as heretofore.

Madras.—Model cow-houses beyond the thickly inhabited parts of the city were under construction in 1914. Stringent measures are " taken to prevent stabling of milch cattle in dwelling houses . . . 995 prosecutions were launched and 379 convictions were secured to enforce the terms of licences dealing with such places." The Government of Madras made a grant of Rs.50,000 in aid of the Corporation's efforts towards building model cow-houses.

Rangoon.—The following are measures adopted by the Municipality of Rangoon† :—

" Briefly, the measures which it is proposed to take are (*a*) the prescription of bye-laws regulating the sanitary condition of dairies and places where milch animals are kept for profit, one of the bye-laws being that every owner of milch cattle kept for sale of their milk, and every occupier of a milch cattle stable where cattle are so kept, shall admit at all times the Health Officer or Veterinary Officer or other Officer appointed by the Committee for the purpose, to inspect the premises occupied by them and

*Statesman (Calcutta), 17.9.15.

†Report on the Working of the Rangoon Municipality. 1914–15. p. 10.

the cattle therein for the purpose of carrying out the provisions of the bye-laws; (*b*) the establishment of a depôt where all imported milk shall be tested; (*c*) the prescription of bye-laws regulating the sale of milk within the limits of the Municipality. For the purpose of these bye-laws, standards are prescribed for milk that will be deemed to be "pure milk" and "watered milk," all vendors of milk must be licensed to sell pure or watered milk, as the case may be, and all watered milk shall be kept only in vessels labelled as containing watered milk. As regards imported milk the licence provides that the licencee shall not sell or expose for sale milk which has been obtained from a dairy situated outside Municipal limits unless such milk has passed through the Municipal depôt and various other conditions to ensure the same control over dairies situated outside Municipal limits as in the case of dairies situated within Municipal limits."

The idea of permitting "watered milk" has reference to the greater percentage of solids and fat in buffaloes' as compared with cows' milk. In the writer's opinion there are strong political and hygienic reasons why such a method should not be adopted by any public body, and particularly by one dealing largely with an Indian population.

The Uganda Township Ordinance.

In the *Uganda Official Gazette* of the 31st January, 1916, is published new "Township Rules" under the above Ordinance. Many of these are elaborate and of a well conceived character, and must mark a vast advance in Communal Government in the area concerned, more especially in respect to structure of dwellings. Of rules of direct sanitary importance, the following are of interest:—

Rule 22. No well shall be dug "without written permission," and it shall be provided with a masonry steining and closely fitting cover.

Rule 23. Any collection of water or liquid containing mosquito eggs, larvae or pupae, is a nuisance to be summarily dealt with.

Rule 24. Water may not be stored unless effectively screened or kept covered with a film of kerosene oil.

Rule 25. "(1) The occupier, or, if there is no occupier, the owner of any premises shall:—

"(*a*) Keep such premises free from stagnant water; and

"(*b*) Keep such premises free from bottles, tins and other articles which may retain water and from all plants or vegetations which are known to retain collections of water, suitable for the breeding of mosquitoes, or favour by their nature or position the breeding of mosquitoes.

"(2) The presence of mosquito larvae or pupae in any collection of water shall be sufficient evidence that such water is stagnant."

Rule 26. The occupier or owner of premises is required to cause all cesspools and cesspits in such premises to be "oiled" and all catchpits to be cleaned once weekly.

Rule 27. "The occupier or, if there is no occupier, the owner of any premises shall maintain all drains, culverts, drainpipes and guttering on such premises in good order and repair and free from obstruction and in such a manner that water cannot accumulate therein."

Rule 28. "The occupier, or, if there is no occupier, the owner of any premises shall cause all ponds, pools, or excavations which may contain stagnant water on such premises to be filled in or drained or kept covered with a film of kerosene oil."

Rule 29. Building material may be obtained by digging from spots approved by the Township Authority. But, "Such permit shall be subject to the condition that the person digging shall cause all holes dug by him which may contain stagnant water to be filled in, drained or covered with a film of kerosene oil, and such other conditions as the Township Authority may think fit to impose."

Rule 30. "All projects for drainage or irrigation or for the plantation of areas or watersides shall be submitted to the Township Authority for approval, and shall not be carried out without such approval in writing."

The following is the form of notice requiring abatement of mosquito nuisance :—

"Form of Notice requiring Abatement of Mosquito Nuisance.

"Uganda Protectorate, Township of——

"To (*person causing the nuisance or owner or occupier of the premises at which the nuisance exists, as the case may be*).

"Take notice that, under the provisions of the Township Rules, 1916, the Township Authority being satisfied of the existence at (*describe premises where the nuisance exists*) of mosquito larvae breeding in (*describe the place ; for instance a well, barrel, excavation, or cesspit*) or of conditions which are favourable to the breeding of mosquitoes, insects, or parasites (*describe the condition, for instance, broken bottles on walls or an improperly constructed surface drain, or an unscreened tank*) does hereby require you within (*here specify the time*) from the service of this notice to abate the same, and for that purpose to (*specify any works to be executed ; for instance, fill up excavation, oil cesspit twice a week, etc.*) (and the said Township Authority does hereby require you within (*here specify time*) to do what is necessary for preventing the recurrence of the nuisance and for that purpose to (*specify any works to be executed*).

Dated this day of 191

Signature of Executive Officer of Township Authority }

."

Note.—*Rule* 22 provides a power of an unusual character, in not apparently requiring the Township Authority to assign a reason for electing to fill in a well. No difference is apparently contemplated between public and private wells.

Under Rules 23–25 (2) action must often be deferred, owing to it not being proved that water likely to favour mosquito propagation contains eggs, etc. If legal quibbles are feared as to definition of stagnant water, it should be possible to define stagnation for the purpose of this Rule by the absence of a rate of flow known to be inimical for mosquito propagation. Again, under *Rule* 28, instead of it being necessary to wait till an excavation "may contain stagnant water," a minimum gradient to secure removal of surface water from premises might be enforced in each case as prescribed by the Authority. An *additional* power of this character would be advantageous.

Rule 26, contrary to the mode used in the remaining Rules *ad hoc*, employs the word "oiled" without requiring a "film," and without stating the nature of the oil to be used. *Rule* 29 may not secure the object in view, owing to the somewhat loose use of the proviso "which may contain stagnant water." It is evident from the use of the clause "or covered with a film of kerosine oil" in *Rule* 29, that both here and in *Rule* 28 by the phrase "may contain stagnant water," no condemnation of the shape, size or position of any surface depression is contemplated, on the ground that at some future time (e.g. after rainfall) there is risk that water in a stagnant condition may be found within it, but that no condemnation can occur unless stagnant water is a present condition—a "wait and see" policy. These particular Rules in the caution exhibited are in considerable contrast to *Rule* 22 and those concerning syphilis. This Rule would not meet the condition that during excavation holes should be so shaped or drained as not to allow of retention of water. *Rule* 30 is an excellent provision and should prove of much value in malaria prevention.

In regard to disposal of night soil, power is taken to require the owner to make such arrangements as the Township Authority thinks fit, " or it may itself provide for the removal and disposal of night soil;" but this Rule fails to provide power to recover cost of such proceedings from the occupier or owner of a house.

In the matter of syphilis, the Rules are of a most stringent character and rest for their success upon *vis a tergo*. If this suffices and is politically suitable much good must result.

Factories.

In the Madras Presidency, the people are beginning to appreciate the importance of development of industries, with the result that factories supplied with modern machinery are becoming more in evidence than formerly in District Municipalities. Timely legal measures to secure their orderly and hygienic management have therefore become necessary, irrespective of powers already possessed by the bodies concerned to control " Dangerous and Offensive Trades." An amendment of the Madras District Municipalities Act of 1884 is therefore before the Legislative Council of the Local Government. The Amendment provides that :—

" If in any existing factories any nuisance is likely to be caused by the particular kind of fuel employed or by excessive noise or vibration, the council should be empowered to give directions for the abatement of the nuisance in the first instance. If the nuisance is not abated within the time prescribed, or if the abatement is found to be impracticable, the council is empowered to restrict the hours of working and restrict the kind of fuel that may be employed for working the factory or mill. . . . Several provisions have been introduced for the purpose of safeguarding the rights of persons who are owners of mills, or who intend to put up mills, against any possible oppressive use of their powers by the municipalities." It has been " provided that if a municipal council does not pass orders on an application for permission to construct a factory within three months after the receipt of the application, the application should be deemed to have been sanctioned ; . . . also that if any individual should think that the municipal council has been exercising its powers in an arbitrary or oppressive manner, he can apply to Government for revision."

TREATMENT OF WASTE.

The Economics of Conservancy.

Collection of Excreta.

At page 476, Vol. 5, of this *Bulletin* [Sanitation Number] the writer referred to the fact that the amount of urine largely decides the weight and bulk of the total excreta of a population. When dealing with certain tropical races employing water for ablution, as against the various less decided modes of cleansing after defaecation ordinarily selected by occidental nations, the matter of bulk of fluid to be dealt with becomes still more serious.

It is well recognised that ammonical decomposition is less likely to be evident if faecal matter be collected without urine or added water. It also should be definitely recognised that it is not just to insist upon the poorer classes of a population in the tropics resorting to public latrines that are not as free of offence to the senses of smell and sight as reasonable expenditure can secure. In the absence of this effort, the preference for a cleanly space on mother earth and the sky for a roof is not surprising. So long as a population is not able to afford a sewerage system, the possibility of adopting a separation system must, therefore, be of interest to the sanitary officer concerned.

Numerous forms of latrines have been devised for separating the urine from the faeces, but the designers ordinarily carry the problem no further. They leave the same mass of faeces and urine to be removed by separate modes of transport, and thus, probably, add to cost by more expensive plant and staff not only for collection but for transport.

In this *Bulletin*, Vol. 4, p. 461, it was shown how simple forms of aerobic filter pit latrines, devised by the writer, could be employed to fulfil requirements of the separate system. Diagrams annexed show other forms of latrines for the same purpose designed by him, which also fulfil the requirements of separation of urine and faeces. Lt.-Col. Williams, Sanitary Commissioner for Burma, has advised their use in that country, and has stated officially his preference of them to certain well known iron latrines on the market. They are in practice necessarily not so devoid of odour as filter pit latrines. They could of course when adapted to private houses, institutions, or small towns be better worked by placing in the pans for receipt of faeces dry earth, ashes, sawdust, or paddy husk; but in public use such additions, especially dry earth, add greatly to cost, by increasing bulk and weight of material to be carried. Quick removal and retention in special covered receptacles, close to the latrines, of faeces pending transport in that case must be practised. When water is used for ablution* it would be necessary to add an additional compartment at the head of the drain, which should not be provided with a pan. Here water should be supplied by tap served by a covered cistern or barrel external to the latrine. The water used for ablution thus helps to flush the drains.

*Burmans use sticks.

Fig. 1 shows an ovoid, cement lined, or salt-glazed stoneware, drain, such as used for surface drainage. The drain is divided by screens into lengths purposely offering no more space than absolutely requisite for average individuals; the object being to limit defilement of surfaces. For the same reason footpaths are restricted in size. On the curb of the drain, a receptacle is placed, as per plan. The breadth of the drain allows a squatting position of 9 inches from heel to heel. The slope of the foot rest is such as to ensure that the user squats *à la Turque* in the required position, so that the faeces pass to the pans and the urine to the drain. In construction, care must be taken to see that the exact position of the foot rest, in respect to the front and rear screens, is obtained. *Haphazard measurements of the foot rest, its grade of slope and position will abort the whole purpose of the latrine.*

Figs. 2 and 3 for public and private latrines, respectively, are on the same principle but represent a grade higher in civilisation, as urine does not pass into the drain common to all squatters.

In all cases, if the latrine is situated so that the drainage cone of wells is not endangered, the urine may be received in pit filters immediately outside the latrine or, if on crowded areas, into cement-lined cesspools from which, by a small hand pump attached to an iron cylinder cart, or by vacuum carts, it can be lifted for transport.

Where the use of filter pits is feasible, there is no further trouble as to the urine, as the filtrate disappears by lateral percolation in the subsoil, except that precaution against flies should be taken, either by petroleum sprinkling or wire gauze covering. They should be protected by acute sloped covers guarded by wire gauze. When cesspools for temporary receipt of urine are employed, similar precautions should be taken.

Figs. 1, 2, and 3 get over the difficulty of making a raised platform for receipt of excreta into buckets placed below as commonly employed, and this method is cheap in execution.

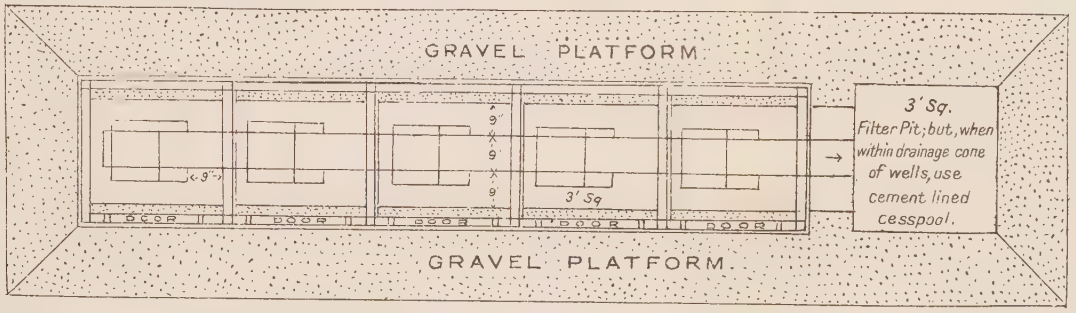
Fig. 4 shows a reinforced concrete latrine designed by the writer in 1906, which is faced with glazed stoneware in parts touched by urine.*

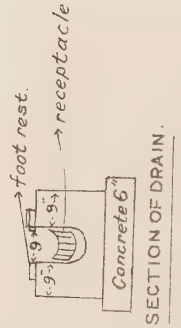
When it can be afforded all other parts should be covered with white glazed tiles set and pointed in cement. The platform can be raised on supports (see diagram) for use with a bucket, or this can be dispensed with and a pan be used as in the other latrine. In this latter form, it can be adapted for use either with the separation or water carriage system in hospitals for races using the squatting attitude. Although shown as a single platform, the pattern can, with economy, be employed for any number of continuous seats,* separated by partitions, for public latrines. For small institutions, there is no difficulty in adding hoppers so as to imitate the usual arrangement for dry earth

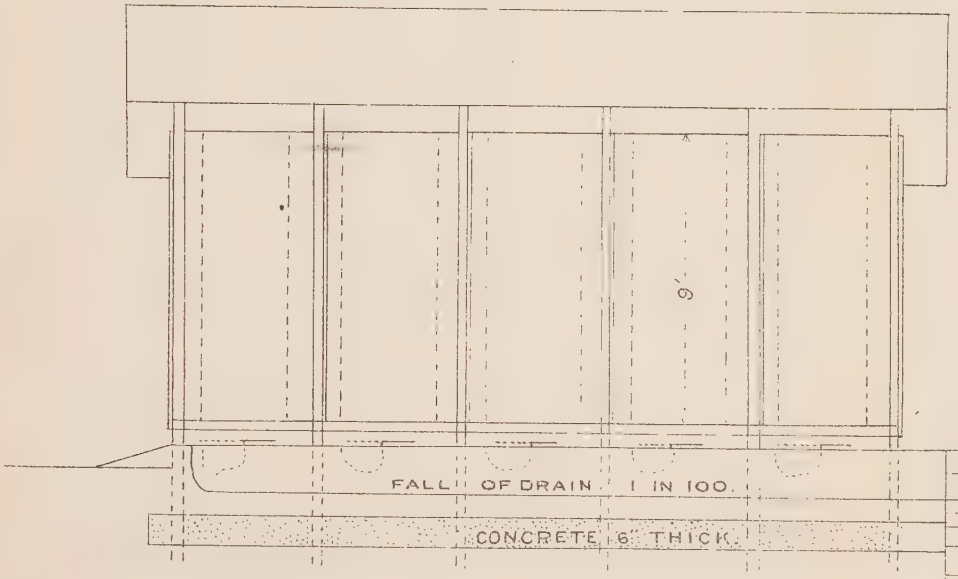
*This form of latrine is of special advantage where the cost of transport is great or risk of rough treatment likely. In this case the transport of casks of cement and iron rods for reinforcement, is a much simpler matter than in the case of iron latrines or platforms. It is very difficult to construct cheaply *complete* glazed stoneware latrine platforms, and equally difficult to transport them without breakage. Further, if the drain is to be all in one piece with the body, elaborate work would be necessary to secure a series of seats with a continuous drain of a desired gradient. Hence, the advantage of the glazed stoneware being continuous only where in contact with urine.

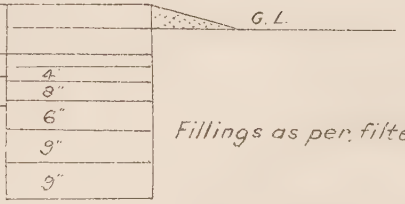
RECEPTACLE DRAIN LATRINE. Fig 1.

SCALE 4′ = 1″.



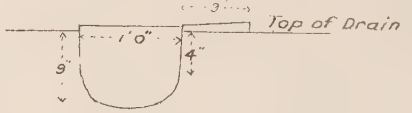






Fillings as per filter pit.

ENLARGED SECTION OF RECEPTACLE.



SCALE 1′=1″

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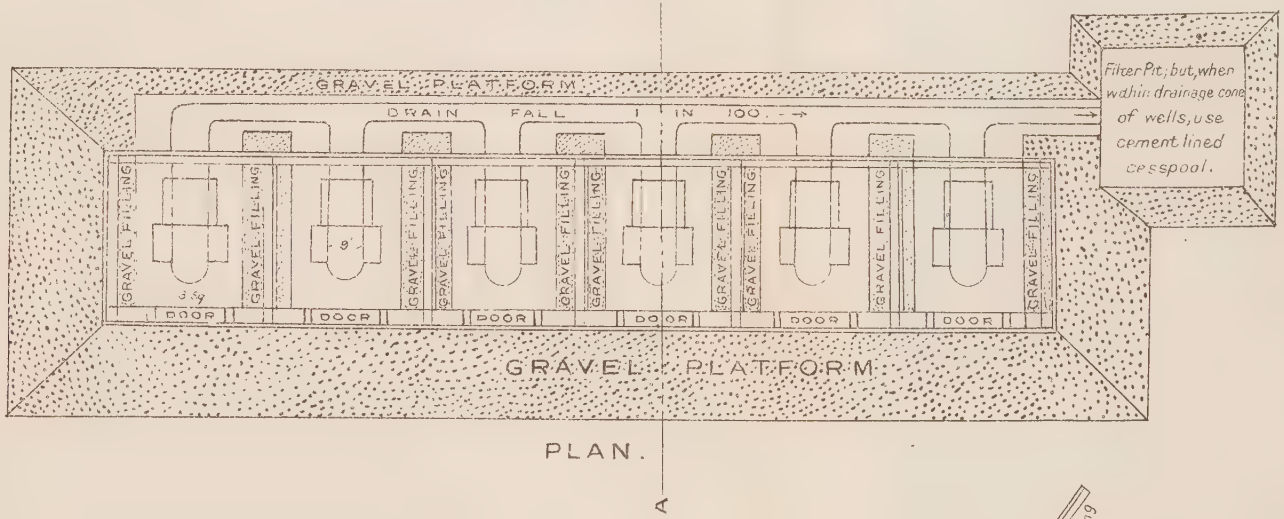
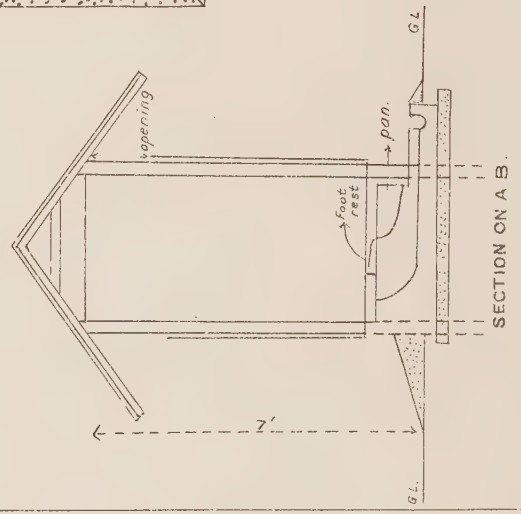


PLAN.



RECEPTACLE DRAIN LATRINE

Fig 2.

SCALE 4' 1".

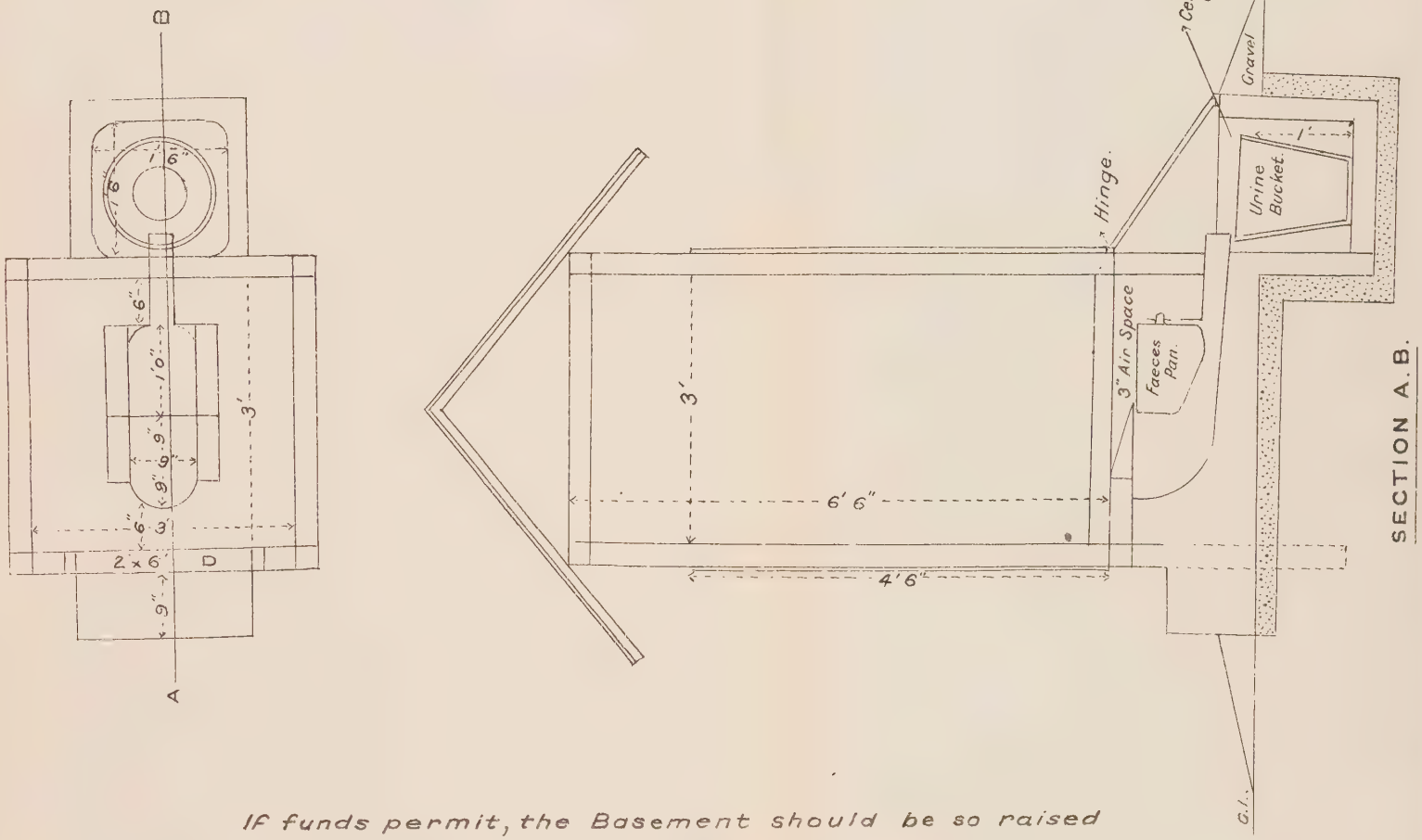
Malhué & Son

5288

SEPARATE SYSTEM PRIVATE LATRINE.

Fig 3.

SCALE 1/12



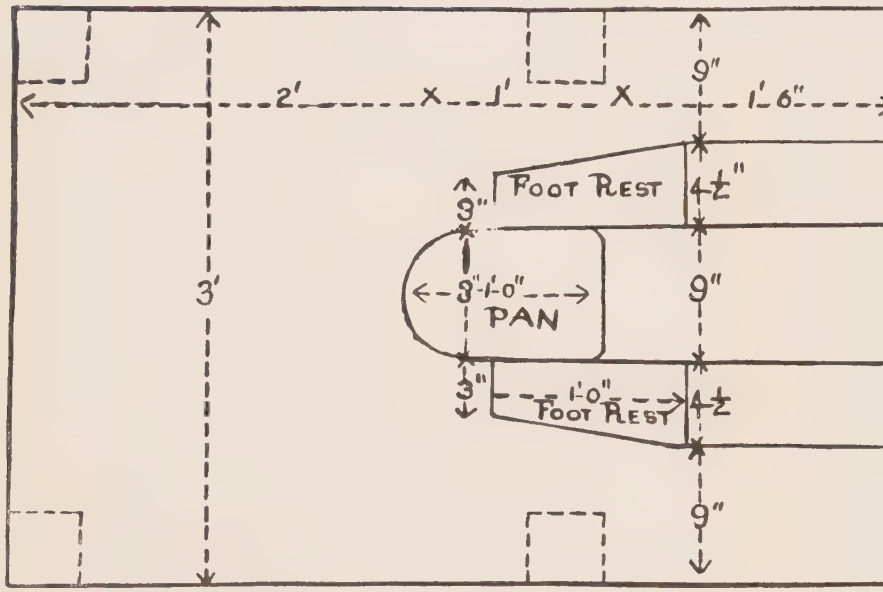
If funds permit, the Basement should be so raised that the Urine Bucket rests on a Concrete Platform which will be flush with G.L.

Malby & Sons, Lith

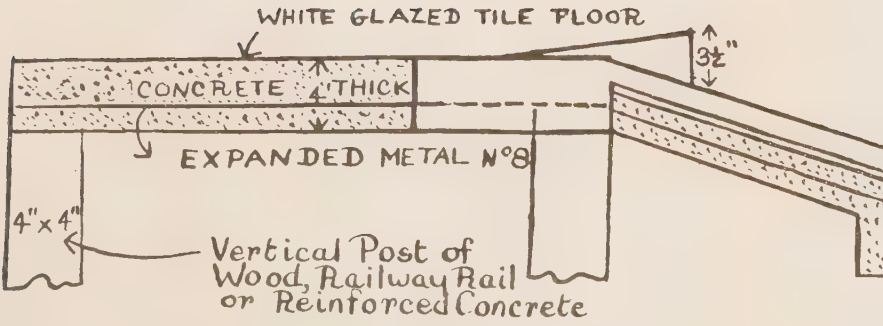
RE-INFORCED CONCRETE
LATRINE

Fig. 4.

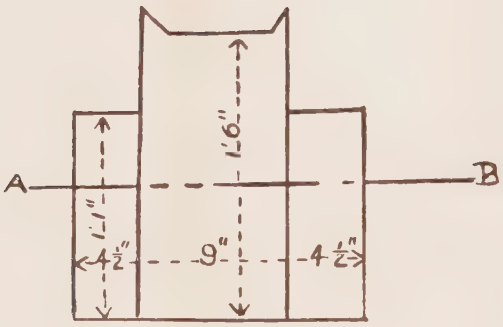
SCALE = $1\frac{1}{12}$



PLAN

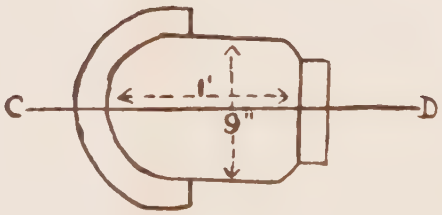


SECTION

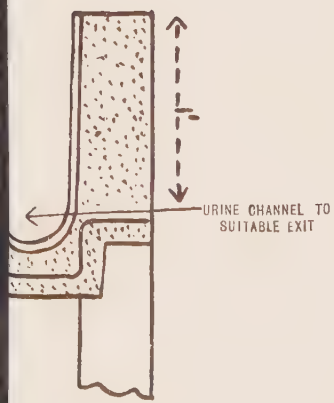


URINE SLAB
(GLAZED STONE WARE)

SECTION ON A. B.



RECEPTACLE



SECTION ON C. D.

closets. Here, instead of employing separate buckets or pans, the faeces can be received into a trough on wheels containing dry earth. The trough can thus be dragged to the place of deposit of night soil to the saving of labour and plant.

The whole of these latrines should by means of wire mesh (11 wires to the mesh) be rendered fly-proof.

The Economy of Waste.

The Madras City Corporation Report for 1914 shows that a sum of Rs.37,438 was realized from contracts for grass on the chief sewage farm. The area placed under broad irrigation with sewage was originally a bare sea-sand waste.

Open earthen channels which were tried experimentally for the conveyance of sewage in place of the semi-circular cement pipes in use, have been found to work most satisfactorily. The cement pipes in the farm are being gradually removed, and replaced by earthen channels, and this is specially noticeable in the portions of the farm improved during the year.

On account of sale of rubbish, the sum of Rs.16,957 was realized.

In the Cairo sewerage scheme recently completed, sewage irrigation of 3,000 acres of desert land is provided for.

SANITARY WORKS.

Irrigation and Malaria.

It is no new matter for it to be recognised that the actual irrigation of a field is not the great factor in placing water at disposal for mosquito breeding, but the failure to provide for its prompt removal after it has done its duty and that of waste water from the supplying canals or distributing channels. In dealing with the main canals, the amount of waste by seepage depends greatly upon whether or not the water is carried at or below ground level. The latter condition has been aimed at in more modern constructions, with the hope of minimising subsoil and surface water-logging; often at greatly increased expenditure and loss of head. But, even when these are faced, much depends on the nature of the subsoil. Thus, in the Kurnool District of the Madras Presidency, where laminated limestone rock predominates, water from the Kurnool-Cuddapah Canal may be found, in many parts of its course, permeating the interstices of rock several hundred yards distant from the main canal (which is duly sunk below the ground level) with the result of water-logging of the soil at lower levels, and the usual train of malaria.

To prevent seepage from main canals and from their distributing channels is desirable, not only as an anti-malarial measure but for securing economy of water. This economy in a period of drought with famine threatening the land may be of vast public importance as a life-saving measure; whilst, at times, it must imply the power of extension of the benefits of irrigation to the agriculturist with an accompanying increase of revenue. At p. 570 of Vol. 6 of this *Bulletin* [Sanitation Number], the question of water-proofing was referred to as a matter that was, in India, still in the preliminary stage of suggestion, although the subject had been advocated, according to *Indian Engineering* (which the writer quoted) as far back as 1903.

Fortunately, in America, the matter has gone beyond the mere "talk stage," and there are at disposal according to the *Engineering Record* (New York) of April 15, 1916 [p. 508], enough data as to water-proofing and its results to show that the method is not only sound theoretically but is successful in practice. The following is an extract from the paper:—

"As a result of lining with concrete about 40 per cent. of the canal and lateral system of the Okanogan irrigation project in Washington seepage losses have been reduced from 51 to about 15 per cent. of the total water received from Salmon Creek at the headworks, and an insurance against water shortage during seasons of minimum runoff has been provided. The lining has been placed in the sections of the canals where seepage losses were greatest, these locations having first been determined by current meter measurement. . . .

"The losses in the canal system for 1911, with 43 miles of canals and laterals in operation and only one mile concrete lined, was 51·1 per cent., an average of 1·2 per cent. per mile of canals operated. The loss for 1915 was 20·4 per cent, with 76 miles of canals and laterals operated and 21 miles concrete lined, or an average of 0·27 per cent. per mile of canal operated. Three small laterals carrying from 5 to 15 sec.-ft. have been all concrete lined.

These laterals are from ½ to 1½ miles long, and a careful checking of the weir measurements of all the water turned in and turned out shows that there is practically no loss at all in these canals. About four miles of lining have been placed since the close of the 1915 irrigation season and another 1½ miles will be lined before the season for 1916 opens. It is estimated that this will reduce the losses in the system to less than 15 per cent. for the season of 1916. The capacity of the canals concrete lined has varied from 1 cubic foot per second up to 140 cubic feet per second."

In a further article on this subject the "Engineering Record" of the 22nd April 1916 [540] enters into the whole question of cost and mode of construction. Without touching details which have only professional engineering interest, some rough idea of cost and stability of work can be secured from the following extracts. As to gravel employed it is stated :—

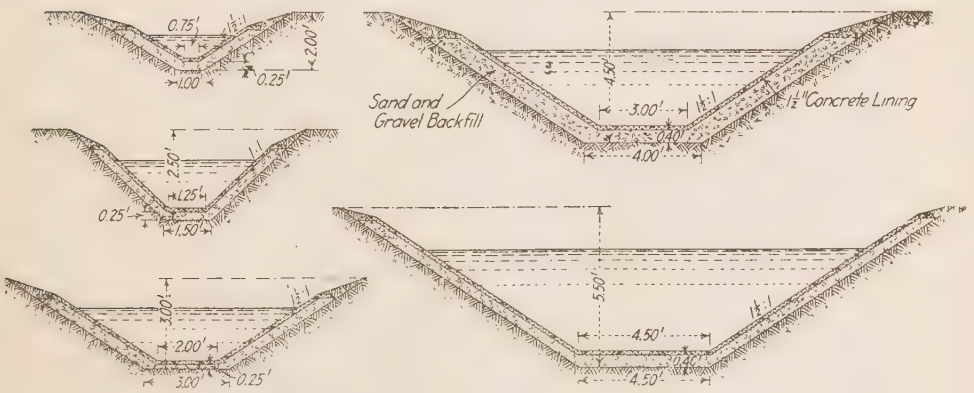
"Everything larger than would pass through a 1-in. mesh screen was taken out. The material, therefore, contained an extra amount of sand, but this was desirable in order to make the concrete easier to plaster and get an impervious surface. Frequent tests were made for the amount of voids in the aggregate, and the amount of cement was varied accordingly. A minimum of five sacks per cubic yard was used and a maximum of six sacks per cubic yard was sometimes required and used. The average for all the work was 5·2 sacks for each cubic yard of concrete placed."

The following statement will aid the sanitarian in calming the conscientious objector to expenditure in water-proofing channels on the ground of cost of upkeep and unsatisfactory wear, especially when exposed to sun action :—

"Part of the lining has been in use for four seasons and has given good service and shows no signs of wear. Up to date it has required no expense for maintenance, except at a few places on some of the first work. . . .

"No trouble has been experienced on account of expansion or contraction injuring the lining, even when the water is rotated and the canal is dry half the time during the summer. In general, the lining has proved very satisfactory and the indications are that it will give good service."

The annexed plans show the section of channels and lining adopted :—



Cross-Sections of Lined Canals.

Influence of Anti-malarial Works.

The following abridged Table from p. 126, Straits Settlement Medical Report for 1914, is significant of influence of anti-malarial measures in Singapore :—

Table A.

Schools.	1911.		October, 1914.	
	Pupils seen.	Percentage with spleen.	Pupils seen.	Percentage with spleen.
Kampong Glam	274	12·4	264	1·5
Rochore	143	18·8	120	1·6
Kallang	69	4·3	92	2·1
Kampong Rokok ..	51	3·9	39	..
Upper Tanglin	45	11·1	58	6·8
Lower Tanglin	67	5·9	66	1·5
Sepoy Lines	46	15·2	42	2·3
Telok Blangah	39	46·1	49	8·1
Kampong Jagoh.. ..	44	29·5	46	6·5
Anglo-Chinese	484	3·0	548	2·5
St. Andrew's Missions ..	..	..	431	1·1

In the Settlements, during 1912, the admission to Hospitals for malaria were 9,172 with 660 deaths; in 1913, the admissions were 8,102 with 499 deaths; and in 1914, 8,129 with 528 deaths. The whole of these cases were diagnosed microscopically.

The Government Pathologist, at p. 111 of the Report, states :—

"The proportion of deaths from malaria as revealed by post-mortem examination is a little lower than last year and much lower than in former years.

Tan Tock Seng's Hospital Mortuary.

Year.	No. of P.Ms.	Deaths due to Malaria.
1907	1,083	212
1908	1,472	372
1909	1,278	241
1910	1,403	314
1911	1,743	434
1912	1,422	216
1913	1,010	105
1914	1,050	90

"If we compare the malaria deaths in 1907 with those in 1914, when the number of post-mortem examinations is practically the same we see that there is a marked improvement. The number of cases admitted in a comatose condition is much diminished."

Double Domestic Water Supplies.

The danger of using two sources of water supply for domestic purposes is well recognised. Equally the evil result of passing through the pipes of a public water supply system, temporarily, water from a source of inferior quality (such as may occur in stress of fire demands,

or in the breakdown of filters following floods or other causes) has been demonstrated from time to time. The Director of Sanitation, Minnesota State Board of Health, has been able to place on record* an instance of temporary passage of untreated river water in a domestic water supply system, which is of interest not only in demonstrating this recognised danger, but in showing that, in the presence of much modern evidence of dysentery being fly-borne, the older theory of its water-borne origin should not be forgotten. He reports :—

" On October 24th, 1914, an outbreak of dysentery among the employees of the St. Paul Union Stockyards Company at South St. Paul, Minn., was reported by the Live Stock Exchange Company to the Minnesota State Board of Health. Investigation showed that about 80 of these employees developed symptoms of dysentery between October 21st and 24th, the majority of them on the night of October 21st. It also brought out the fact that all these persons were using water from the distribution system of the St. Paul Union Stockyards Company. The regular water supply of this company was pumped from three drilled wells. . . . For fire protection there exists a system of mains supplied with water pumped from the Mississippi River through an intake. . . . It was discovered during the investigation that Swift and Company had furnished water to the Union Stock Yards system on October 19th and 20th, at which time Mississippi river water doubtless had entered the Union Stock Yards system as described above."

Analysis showed contamination of the river supply but not of the well supply. The connecting pipes of the double supply were removed and, lest typhoid infection of the sufferers might also be involved, anti-typhoid inoculation was pursued.

Floors.

The use of reinforced concrete floors has decided advantage in buildings, public or private, within the tropics. It is rarely, however, this method is adopted for any but the larger class of buildings. According to the *Indian and Eastern Engineer* (Calcutta) for May 1915, the Indian Concrete Company (Messrs. Octavius Steele & Co., Managers) have introduced a form which should give an impetus to the employment of this character of floor in a class of buildings less pretentious. It is thus described :—

" The system consists primarily of a series of hollow reinforced concrete tubes of such a shape that when placed side by side continuous channels are formed between them. In the channels so formed the main reinforcement is placed, and the channels are then filled with concrete consisting of a mixture of 1 cement, 2 sand, and 4 aggregate, carefully worked in by hand. In one continuous operation a top layer of artificial stone is laid over the whole surface, and thus the tubes, the sides of which are suitably keyed, the ribs and the top layer form a monolithic slab which is continuous over the whole floor. As the tubes are placed against each other in such a way that continuous channels are formed, the main reinforcement is also continuous over the whole length of the floor, without any break whatever, and by varying the amount of the reinforcement the floors can be constructed to take different loads with the same tubes. The reinforcement employed consists of mild steel rods varying from $\frac{1}{16}$ inch to 1 inch according to space. . . . On the matter of cost, the tubular floor can compete favourably with a usual tile floor in small rooms, and in rooms of larger size considerable saving can be effected ; facts which constitute a very noteworthy recommendation of the system."

* U.S. Public Health Reports, 1915. Nov. 26. Vol. 30. p. 3473.

Irrigation and Drainage.

The Director of Public Works, British Guiana, in his Report for 1915 [pp. 19–20] gives expression to that intimate relation of irrigation and drainage, which is to the sanitarian of anti-malarial interest. He states :—

"I am of opinion that all works, both of drainage and irrigation . . . must nearly always go hand-in-hand. . . . Personally, I am of opinion that drainage is a more important matter than irrigation in this Colony and as so many lands are badly developed, or left waste owing to poor and insufficient drainage, I would suggest that the drainage of all such lands be examined and reported on. Probably when the financial situation is better, these lands in need of improved drainage could be dealt with. Also, in the case of new works in the Colony, such as roads, etc., drainage is a vital question and no scheme should be proceeded with until the drainage part of the scheme is worked out and the drainage required should be carried out as part of the scheme.

"It would be advisable also, in the cases of all Village, Sanitary and Country Districts, that the drainage system of these places should be under control, as to keeping it in efficient order, and that certain fixed sizes of sluices and drains be adhered to. At present there appears to be no system as regards these essential details. Sluices and drains are put down by the Chairmen of various districts, and the sizes of same appear to be regulated—not by the drainage area—but apparently by the amount of money available. Cases exist where drainage work has been carried out and it has proved to be inefficient."

Rural Water Supplies in the Tropics.

The vast influence for good of protected water supplies for rural populations needs no argument. Data for such supplies are rarely available, the time of engineers in tropical areas usually being occupied with more ambitious schemes. The following details supplied by *Indian Engineering** convey at once possibilities of simple methods of utility and, in the writer's opinion, reasons for modified complaisance :

"Simple in design and execution and perhaps simpler in its operation and maintenance, the installation represents an attempt to adapt, at a reasonable cost, the main features of an urban model to the needs and conditions of a rural population. The Kaniyambadi Installation consists of a protected well, a hand-pumping plant, an overhead reservoir, and a pipe line serving a number of fountains disposed in convenient situations in the village. The protected well is of the ordinary rural type, 10 feet in diameter and sunk to a depth of 30 feet below ground level, and 10 feet below summer water level. The pumping plant consists of a double-barrelled kite motion pump worked by hand, capable of delivering about 800 gallons per hour against a maximum total head of 461 feet. The working power required at full load, allowing liberally for frictional losses, is about three man-power at the handles. The overhead reservoir consists of a cement-lined covered masonry cistern capable of holding 2,000 gallons. The bottom of the reservoir is 11 feet above the ground. The actual reservoir capacity required is estimated at 1,440 gallons. The pipe line consists of $2\frac{1}{2}$ inches cast-iron piping about 1,450 feet long. It is designed to discharge 6,400 gallons in six hours for a population, allowing for an increase, of about 3,200, which means 2 gallons per head. The quantity allowed per head is found by general experience elsewhere to be sufficient to meet the drinking water requirements of the general community. The supply will be drawn off by the people at five fountains so located as to be easily accessible from all parts of the village."

*Calcutta, 1916. April 29, p. 252.

For the unstated expenditure, there has resulted a supply to the people of two gallons per head of a presumably safe water supply. But this amount necessarily will not supply all the requirements of even a rural population and consequently, existing supplies, which normally are open to contamination, must continue to be the source to a large extent. The same vessels will be used by the people for drawing supplies from both the pure and impure sources, and water for washing domestic utensils and for mouth cleansing (an invariable part of the morning toilette of the Indian) need not be from the pure supply, with the usual consequence of the spread of water-borne disease.

Under these circumstances, it becomes a question as to whether a water supply on these principles justifies its cost.

In the case cited, it may be that the yield of the particular well utilized was the determining factor of possibilities, and that there existed no reason to place better lifting power at disposal. But if the total amount of water available is ample, it is more probable that the decision to use man power for the pump was reached in the belief that engine power was unsuitable for a small population of 6,000, especially with regard to the total of first outlay, and repairs being more difficult than in dealing with a kite motion pump. In arriving at such conclusions, however, the cost of wages of three men for man power would have to be balanced against the pay of a single man capable of driving a kerosene oil engine. This would imply in rural areas, in the part of India concerned, the pay of one reasonably skilled man, at an increased cost of 45 per cent. over the wage of one common labourer. This would leave a balance from the wages of two men towards kerosene oil at, say, 2 pints per working hour. Again, the difference between the cost of the kite motion pump and the kerosene oil engine might be an increase of about 32 per cent. on this one item. If efficiency be regarded, the difference in original outlay and working cost might well be justified. For example, at an expenditure of 2 pints kerosene per hour with an engine costing (in England) £68, there could be lifted 2,000 gallons per hour against a little over half that amount by man-power—provided none of the three coolies takes a siesta [see this *Bulletin*, Vol. 6, No. 5 (Sanitation Number), p. 283].

There must, of course, be a point at which the sanitarian, in the presence of small funds at disposal of a local body, must admit that the provision of at least one source of protected water supply is much better than nothing, but before this sanitarily incomplete arrangement is accepted, in each case, it is well worth while ascertaining whether a small extra initial outlay would not raise a water supply scheme from the status of a mere *placebo* to that of an active factor in sanitation.

In Applied Hygiene if the full equivalent in life saving value of money spent by a public body is to be realized, no " good enough " policy is economical. Under the strain of an epidemic disease, it becomes apparent that the strength of the chain is measured by its weakest link. Manu probably held much the same view in regard to sanitary policy, when he stated " Though the fruit of the kataka tree (presumably *Strychnos potatorum*) makes water clear, yet (the latter) does not become limpid in consequence of the mention of the fruit's name."

LANDS AND BUILDINGS.

Town Planning in Burma.

The following rules suggested by the Sanitary Engineer, after consultation with the Sanitary Commissioner for Burma, are of a useful and suggestive character :—

"*Area of house-sites.*—The fixing of these dimensions involves very important issues. If made too small the result is usually the over-crowding of the site with buildings at a future date. If too large, and with restrictions as to the area to be covered with buildings the upkeep of the unbuilt-upon area is too heavy a tax upon the householder, and sanitation is hampered.

"In Rangoon the sites, which are 60 feet in depth, appear to me to be amply deep enough for the requirements of a town dwelling to be occupied by all but the wealthiest classes, or large firms. The depth of any main building upon such a site should be restricted to 40 feet, thus leaving a yard 20 feet in depth for the use of the occupants, and for the provision of wide space, in addition to the 16-foot drainage space, for the movement of air at the back of the buildings. In a non-sewered town this space admits of placing a privy at a sufficient distance from the dwelling rooms and kitchens, and close to the conservancy lane.

"With a house depth of a maximum 40 feet perflation of air through all the rooms will not be difficult to arrange for.

"The correct minimum frontage to be given to a site is a matter of the greatest importance. There is a strong tendency on the part of site owners to subdivide the frontage so as to provide additional tenements for sale or rental. In Rangoon the frontages are usually 30 feet in the old parts of the town where there is no restriction against buildings over the whole site. This has been found to be too narrow for two separate tenements unless these are divided by only a thin party wall. When two separate buildings are erected on such a frontage each can have an interior width of little more than 10 feet, the depth varying from 40 feet to 60 feet, while a narrow space, which quickly fills with refuse and is difficult or impossible to clean, is left between the two buildings, and between each of them and its neighbour on the adjacent lot. If a masonry building is erected on 30-foot frontage an attempt is usually made to convert it into three separate tenements, in spite of the rule which fixes the minimum width of a habitable room at 10 feet. This width cannot be attained for each of the rooms when there are two outside walls and two partition walls of masonry in the structure, but Municipal Committees are easily persuaded to suspend the rule in such cases.

"If the excellent rule for the provision of a space of 10 feet between the walls of adjacent houses be adopted, then a sufficiently convenient dwelling can be provided on the sites proposed having 30-foot frontage and 40 feet of depth. When it is desired to build a larger and more commodious dwelling two contiguous lots should be taken up for the purpose. In the business part of a town, which will be near to or around the public market, larger house-sites may be provided, with all necessary restrictions incorporated in the lease or in the Municipal Bye-laws to limit the area to be covered by buildings.

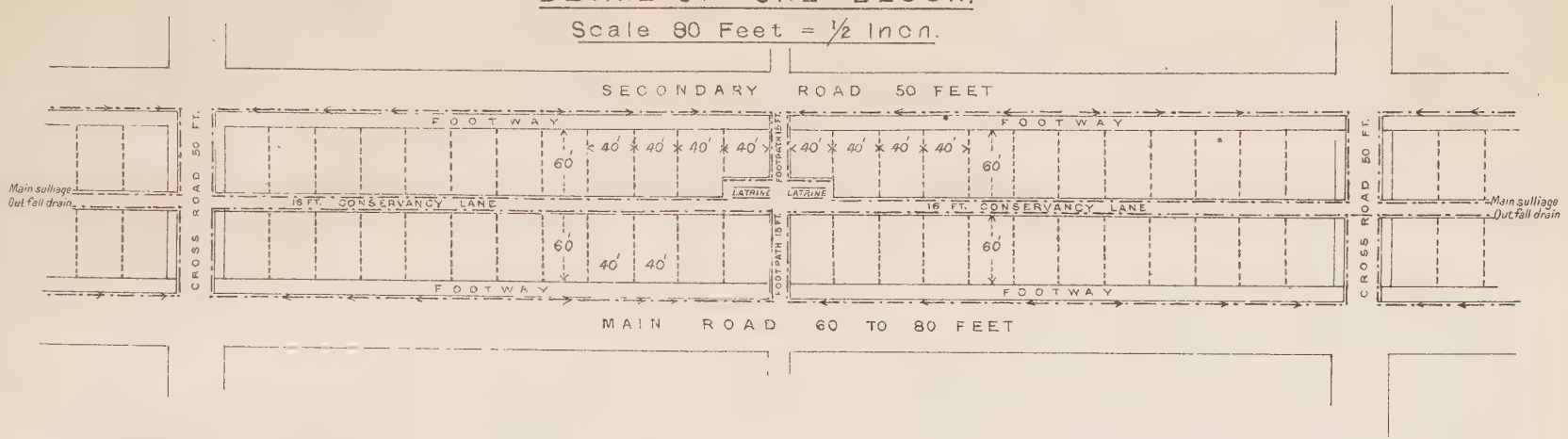
"*Length of block frontages.*—The length suggested by the Sanitary Engineer, *viz.*, a maximum of 972 feet, is based on the length of the blocks in the *pakka* area of Rangoon. I am inclined to consider this length of frontage too great, even with the provision of a footway through the middle of each block. Probably a frontage of 655 feet maximum would be more generally convenient from the point of view of users of wheeled transport. This would give a frontage of 320 feet on either side of the central footways, and allow of eight house-sites on each side of the footway. There would then be sixteen houses to each public latrine of, say, six to ten seats, or a population of, say, 160 persons, of whom perhaps 60 would be provided with latrines in their own compounds."

[Signed] C. E. WILLIAMS, M.D., D.P.H., *Lieut.-Col., I.M.S.*,
Sanitary Commissioner, Burma.

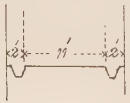
PROPOSED LAY OUT FOR A TYPE BLOCK.

DETAIL OF ONE BLOCK.

Scale 80 Feet = ½ Inch.

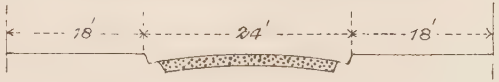


CROSS SECTION OF FOOTWAY.

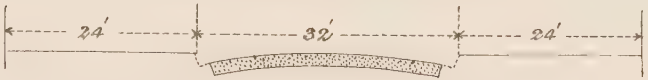


C.S. OF CONSERVANCY LANE.

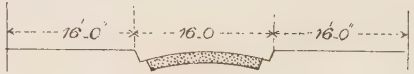
CROSS SECTION OF 60' ROAD.



CROSS SECTION OF 80' ROAD.



CROSS SECTION OF 50' ROAD.



CROSS SECTION OF ROADS & FOOTWAYS.

Scale 24' Feet = 1 inch

5365. P 802.3. 1850. 6.16.

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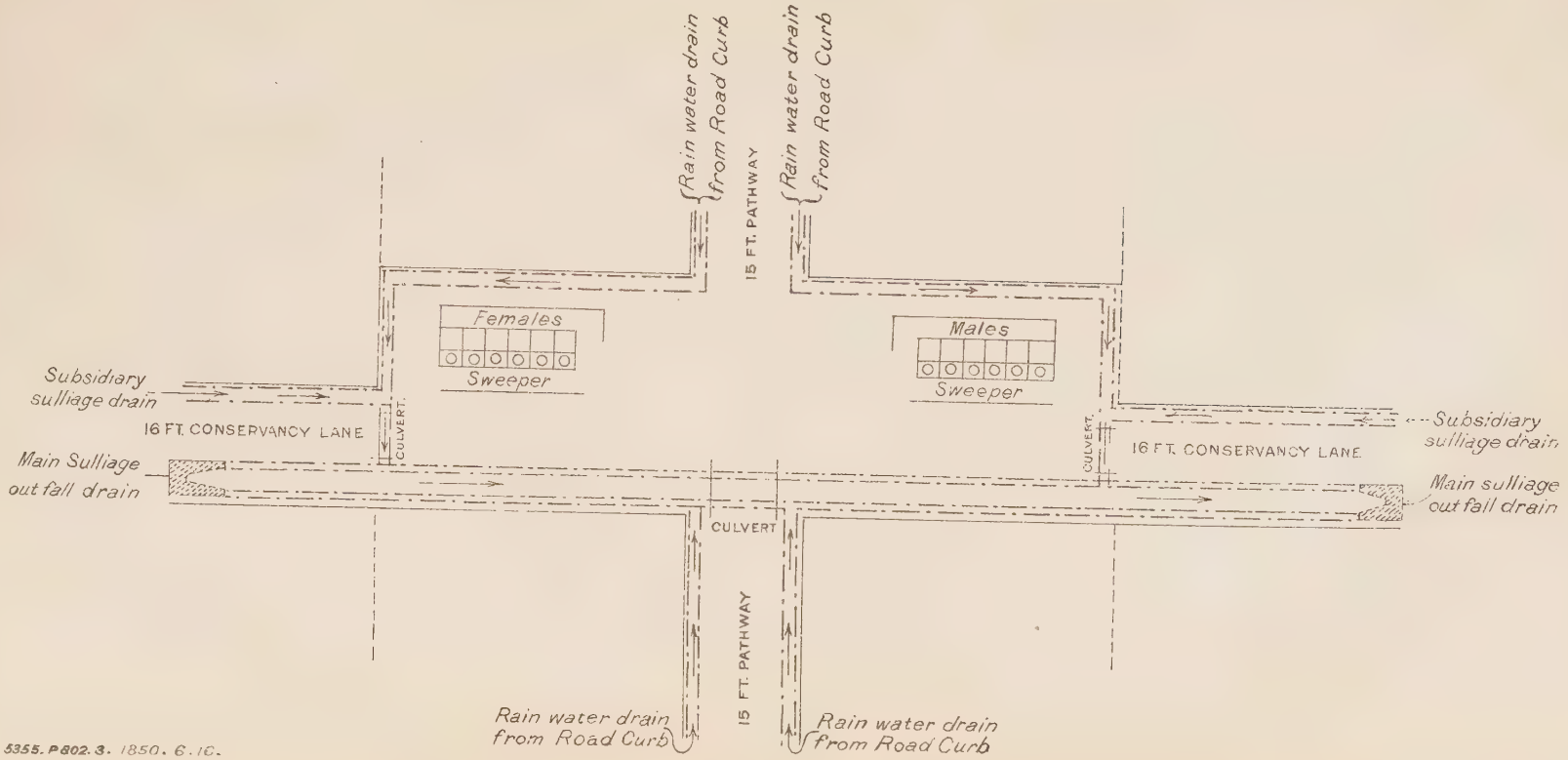
PROPOSED LAY OUT FOR A TYPE BLOCK.

DETAIL OF PUBLIC LATRINE IN CENTRE OF BLOCK

Scale 24 Feet = 1 Inch



5355. P802. 3. 1850. 6. 10.

Ma. by & Sons, Ltd.

"Note on the lay-out of Towns."

"The question of the lay-out of new towns and extensions for existing ones is a matter which calls for early consideration.

"In devising a lay-out there are several matters to be considered :—

"(1) *Drainage.*—The Sanitary Commissioner has proposed that all sulliage drains should be carried along the conservancy lanes and that nothing but rain-water drains should be carried along the road fronts of houses.

"This proposal seems to me one to be commended. It gets rid of the foul surface drains along the front of the houses which are a nuisance both to the inhabitants of the houses and also to passers-by.

"It will entail all householders providing a sulliage drain leading from their houses into the public sulliage drains at the back and the proposal may therefore be resisted by house-holders on the score of expense.

"The proposal contemplates the provision of footpaths along each side of the road, carried right up to the houses. At the junction of the road and footpath a kerb and shallow drain to carry rain-water, this rain-water drain being carried through the centre and round the ends of each block to connect to the sulliage drains, in the conservancy lanes.

"In each conservancy lane would be provided two drains, one the main outfall drain collecting the drainage of several blocks on one side of the conservancy lane, the other a sulliage drain collecting the sulliage of the half block on the other side of the conservancy lane.

"On the sketch attached is drawn out a typical block showing this arrangement of drainage [see figure].

"(2) *Public latrines.*—The siting of public latrines has always been a difficult matter. An attempt has been made to solve the question by placing the public latrines for each block in a space in the centre obtained by cutting off 15 feet from the back of two sides in the block.

"Access by the public is obtained by a footpath from each site in the centre of the block or along the conservancy lane. This proposal is also illustrated in the sketch attached.

"(3) *Roads.*—To provide sufficient light and air it is considered that no road on which houses face on both sides should be less than 50 feet wide over all.

"Main roads carrying considerable traffic might with advantage be somewhat wider, say, 60 to 80 feet.

"Cross roads through blocks which are short length might also be with advantage 50 feet wide over all.

"The conservancy lanes have to provide for a subsidiary sulliage drain about 2 feet over all.

"A main outfall drain, average, say, 5 feet wide over all and a roadway for conservancy carts about 9 feet or a total width of 16 feet will be required as a minimum.

"The footpaths through the centre of blocks have to carry two rain-water drains about 2 feet each over all and a pathway, say, 8 feet wide or a total of 12 feet.

"The Sanitary Commissioner, however, considers that to be of any use in providing light and air they should not be less than 15 feet wide over all.

"To recapitulate, the following minimum measurements might be laid down :—

"Main roads, 60 feet.

"Secondary roads, 50 feet.

"Cross roads through blocks, 50 feet.

"Conservancy lanes or back drainage spaces, 16 feet.

"Footpaths, 15 feet.

"(4) *Blocks.*—The Sanitary Commissioner favours a width of 40 feet as a width of frontage for sites with a depth of 60 feet.

"Allowing 16 feet for the conservancy lane this makes the total depth of a block 136 feet.

"The length of blocks might be limited to 975 feet allowing for twenty-four sites with a 15-foot pathway in the centre.

"Any length appreciably greater than this without a cross road is inconvenient.

"There is no reason of course why the blocks should not be shorter if desired.

"(5) *Markets.*—In laying out any new town it is most necessary to make ample provision for a market or bazaar. A square 400-feet by 400 feet with a 60-foot road all round is not considered an excessive measurement to lay down as a minimum."

[Signed] E. GABBETT,
Sanitary Engineer.

The Lease of Reclaimed Land.

The Bombay Government in a Resolution laid down the following ruling as to lease of certain land reclaimed by the Bombay Improvement Trust* :—

"1. The Chairman, City of Bombay Improvement Trust, should be informed that Government are prepared to agree to lease the reclaimed land in question, after the expiration of the period to be leased by the Improvement Trust, on the following conditions :—

"(i). That the lease shall be for 900 years.

"(ii). That the restrictions imposed by the Trust as to the area to be built over shall continue during this period.

"(iii). That the rent shall be half per cent. per annum on the valuation of the land for the first hundred years, one per cent. for the next hundred years, two per cent. for the next hundred years, three per cent. for the next hundred years, and four per cent. for the remaining five hundred years.

"(iv). That this rent shall be irrespective of vacant area and area covered with buildings.

"(v). That the valuation of the land for the purposes of calculating the rent shall be taken at Rs.5 per square yard.

"(vi). That the lease shall be drawn up by the Solicitor to Government at the expense of the lessee including the stamp and registration fees.

"(vii). That these terms shall hold good whoever may be the Trust's tenant.

"2. The Chairman should also be informed that a probable future sea-face road should not be lost sight of in any agreement made."

*Administration Report of the Municipal Commissioner for the City of Bombay for the Year 1914–15. Vol. II. Annual Report of the Executive Health Officer for 1914. p. 104.

Book Reviews.

Watson (Malcolm) [M.D., C.M., D.P.H.]. **Rural Sanitation in the Tropics, being Notes and Observations in the Malay Archipelago, Panama and Other Lands.**—xvi + 320 pp. Demy 8vo. With Illustrations. 1915. London: John Murray, Albemarle St., W. [Price 12*s.* net.]

Of work in the Tropics fulfilled with the microscope, and its connected ologies in the clinical investigation of disease, books and journals have an endless record. These records beyond calling for passing admiration of the brain power and perseverance of their authors, by bringing about modification of methods of curative treatment, prove at times of utility to the individual; but it is rarely that their true value is appreciated until the man of Applied Hygiene—the sanitarian—secures utilization of their teaching in practice, for the benefit of communities. If a great truth has been revealed in the laboratory and public advantage is not only possible but capable of proof therefrom, what task could be simpler than that allotted to the sanitarian of placing the facts before the administrators of public funds, and shaking hands with himself as he witnesses the defeat of epidemic scourges. But a sea of trouble awaits the launch of a scheme by the sanitarian, and unless he be prepared not only to build a seaworthy ship but steer it personally through storm and tempest to the destined harbour, he must rank as a mere paper spendthrift; the scheme is not the end but the commencement of his work. If it but touch a point of public policy, he must be prepared for essays by venerable officials and by the "oldest inhabitants" of the area affected, on the rending of society, if not revolution, his absurd faddism will bring about; representatives of engineering and finance will prophesy bankruptcy of local bodies if not of central governments, and pray the country may be rid of men void of all sense of proportion, whilst counter schemes by the dozen may have their advocates. Unless the sanitarian is prepared to meet these essay writers on their own ground with all charity and tact and "bide and fecht," he will find he has mistaken his profession. This demands staying power, which, if it exists, few care to exercise—even with the knowledge that the lapse of the proverbial ten years may find his proposals adopted. As a result, the survival of would-be sanitarians in the Tropics is comparatively rare; men lured by the glamour of life-saving to adopt Applied Hygiene as a profession, are apt early in their careers to forsake it in disgust.*

If, then, the sanitarian recognizes that the launching of a scheme implies that he must be prepared to defend it against all comers, the data on which his schemes are founded must stand the proof of free discussion.

The moral of the foregoing in a review of a book with the above title is not far to seek. The work is by Dr. Malcolm Watson of Malaya fame, who has earned the right to be regarded as a *practical* tropical sanitarian. Instead of wedding himself to this or that method of waging war against malaria, he has used all means reasonably applicable to the localities concerned. By splendid perseverance, he has converted representatives of labour and land interests in Malaya from being lukewarm believers into strenuous advocates of anti-malaria methods and, in witness of their faith, they have not failed to give his schemes full financial support. It has not sufficed for him to give it as his *ipse dixit* that drainage is the radical agent against malaria, and that this is compatible with sound agriculture; it has been essential that he should meet objections by those who doubt and the enquiries of the almost convinced. For this purpose, after toilsome field work in the hills and plains of the Federated Malay State, continued from year to year, he has been able to demonstrate the particular mosquito malaria bearers which wasted the planter's chances of profit; and, upon information so gained, he has suggested minor sanitary engineering schemes

*The Government of India in a Resolution on Sanitary Organization (prior to the present war) declared difficulty existed in filling posts reserved for sanitary specialists.

which in execution have proved their soundness financially and in life-saving. This thoroughly practical method of working obviously could be improved upon by not only collecting trustworthy data in a special locality, but by searching for and contrasting results of efforts under analogous conditions in other countries. This, then, is the leading feature of his work.

Irrespective of an interesting account of how, step by step, Dr. Malcolm Watson arrived at his choice of methods in Malaya, the book describes a tour in other tropical countries where anti-malarial measures have been accomplished or are in progress. The text, from paragraph to paragraph, breathes the enthusiasm of the practical sanitarian in the appropriate task of weighing evidence after personal inspection and enquiry, and doing his best in the public interests to arrive at unbiassed conclusions. In fulfilling this function, Dr. Malcolm Watson has not only produced a book affording interesting reading, but one which is replete with information useful to the sanitarian in the tropics.

W. G. K.

Lukis (The Hon'ble Surgeon-General Sir Pardev), [K.C.S.I., V.D.] & Blackham (Lt.-Col., R. J.), [C.I.E., R.A.M.C.]. **Tropical Hygiene for Residents in Tropical and Sub-Tropical Climates.**—3rd Edition. Revised and Enlarged. 302 pp. Crown 8vo. With frontispiece and 52 text-figs. 1915. London: W. Thacker & Co.; Calcutta: Thacker, Spink & Co. [Price 4*s.* 6*d.* net.]

This work is stated by the authors to be "for residents in the tropical and sub-tropical climates." This represents a wide field of suggested utility, which is further increased by the statement in the preface to their third edition, that they hope it may be "useful not only to students of Elementary Hygiene but to junior practitioners and students of medicine." Copies of the work have been issued by the Indian Council of the St. John Ambulance Association" in India and to Territorial Officers. The authors must have found themselves confronted by difficulties in selection of matter that would be suitable for consumption at once by lay residents, the medical student and the junior practitioner. To fulfil so difficult a programme either there must be strict attention to many practical details or, these being lightly assumed as known to the reader, the work must be largely devoted to a systematic treatment of Hygiene. Failing a recognition of either method, there must result the inevitable compromise of the production of a book which cannot serve both standards. It is therefore not surprising that traces of halting between two opinions are at times discoverable. For example, whilst the layman might without hesitation accept the statement that "diarrhoea if allowed to run on may develop into cholera" [p. 8], the junior practitioner might doubt it, in the absence of a simultaneous reference to the *causa causans* of cholera according to Koch, and the latter might also "hae his doots" if beriberi be held to be an "infectious disease" without qualification [p. 97]. Similarly [p. 70] the following diseases, which individuals are stated to be liable to contract owing to "vitality which has been lowered" by constant overcrowding, seem to have been grouped with more reference to instruction of the layman than the junior practitioner:—(1) Indigestion, (2) Bronchitis, (3) Pneumonia, (4) Weakness and Debility, (5) Heat Stroke. They are also said to be "very liable to contract other diseases such as consumption, inflammation of the lungs or bronchial tubes, dysentery, cholera, plague, small-pox, typhoid fever, measles, diphtheria, as well as severe inflammation of the eyes called ophthalmia."

In the matter of cholera, useful hints are given to the householder and the importance of the provision of a pure water supply is duly urged as an important preventive measure; but to guard against chance contamination before consumption, the only suggestion made is the use of permanganate of potash. The authors possibly trust to the adoption of their sound advice, afforded in the chapter on water-supply, that the boiling of water "should be universally adopted in Indian households"; but, having regard to the aim of the book, to miss the opportunity of urging the "tea-kettle policy" in reference specifically to cholera, seems undesirable.

On the subject of plague, the position is taken of asserting that the "question of prevention is a very simple one" [p. 15]. Elsewhere, it is stated, "the whole question of the prevention of plague is one of domestic hygiene" [p. 13]. These are opinions which would make a sharp cleavage between communal and domestic hygiene and the responsibility of the State, and which not a few sanitarians and philanthropists may reasonably consider open to discussion. In the matter of conveyance of plague, the reader is warned that "a plague patient is not infectious and that there is no need for being afraid of going near him." This is a dangerous generalization, in that it ignores primary and secondary pneumonia and the possibility of transfer of infected fleas; it also is forgotten to guard the generalization by a differentiation of conditions in a well kept hospital and the average hut.

Whilst the tendency towards systematic treatment of hygiene as opposed to practical details for the layman's use in the major portion of the work is marked, there has resulted the collecting of a mass of information which should be of great utility to the numerous peoples embraced in the term—the "residents in tropical and sub-tropical climates."

W. G. K.

Gorgas (William Crawford) [Surgeon General]. **Sanitation in Panama.**—298 pp. Crown 8vo. Illustrated. 1915. New York & London: D. Appleton & Co. [Price 7*s.* 6*d.*]

Seven years ago Sir Rubert Boyce published a work with which he hoped to stimulate British interest in the progress of tropical medicine and in the growth of sanitation in tropical climates. He chose as an attractive title the question:—"Mosquito or Man?" Is man to "wrest vast provinces from the sway of the insect pests" or are these pests to defy the colonist and traveller when he ventures into their domain? No better reply could be given to such a question than the excellent work recorded by Surgeon-General Gorgas, Chief Sanitary Officer, Panama Canal and Major-General in the "U.S.A." army.

Although the title of General Gorgas' work is "Sanitation in Panama" the first nine chapters deal with sanitary work in Havanna. The years of apprenticeship spent in Havanna provided General Gorgas and his staff with knowledge and experience without which the work in the Canal Zone would have presented greater difficulties, or might even have failed altogether.

Chapter I. gives a general outline of the harm done to life, wealth and property in various parts of the United States infected with yellow fever during the two hundred years which preceded the Spanish-American war. The disease spread along the Mississippi valley as the population increased and spread. The deadly epidemic of 1878 was one of the worst known in the United States. "In this epidemic over thirteen thousand people in the Mississippi valley alone lost their lives, and the loss of wealth is estimated at considerably more than one hundred millions of dollars." The evil is, moreover, not confined to the actual area of the epidemic. The dread of the disease keeps ships from the ports and merchants from the markets of the affected area. Labour becomes scarce, crops are neglected and poverty and depression, sometimes to an appalling extent, remain in the wake of a yellow fever epidemic. The description given, though restrained, is sufficiently terrifying. Fortunately the disease has never become endemic in the "U.S.A."

The infection generally came from some part of the Gulf of Mexico or from the coasts of the Caribbean Sea. The chief centre of this area of infection was the city of Havanna in the island of Cuba. In 1898 when Cuba came under the American Government the true cause of the infection was unknown. Yellow fever was considered to be a contagious disease conveyed by filth and the vomit and excreta from the sufferers. Major Gorgas, being immune to yellow fever, applied to go with the troops to Havanna and made every effort to have the city put into a sanitary condition. He writes:—"By the middle of the year 1900 all the city Governments were perfectly organized and were accomplishing all that it was

possible for them to accomplish. I believe that Havanna was cleaner than any other city had ever been up to that time." But in spite of all these efforts the attacks of yellow fever grew worse and the Cubans pointed out "that the very cleanest and best kept portions of the city" were the worst places for yellow fever. Yet this good work helped on the discovery of the real method of infection. Attention was turned to the Bacillus of SANARELLI, but after investigation Drs. REED and CARROLL showed that that bacillus was identical with the bacillus of hog-cholera. It had nothing to do with yellow fever.

Following step by step the work of the local commission and sanitary staff in Havanna we come to the Commission appointed by General George M. STERNBERG, then Surgeon-General of the "U.S.A." with Dr. REED as its chief. After visiting Havanna and disposing of the claims of SANARELLI'S bacillus they turned their attention to the theory, strongly advocated by Dr. Carlos FINLAY, that yellow fever was in some way conveyed by a mosquito, *Stegomyia fasciata*. The gradual progress from Dr. FINLAY'S suggestion to the experiments of the "Reed Commission," in Chapter II., make most interesting and fascinating reading. General Gorgas not only has a valuable story to tell but he tells it well with pleasant wanderings into local history and legend. Fortunately the Commission could obtain volunteers for experiment. The immune inhabitant of Havanna could command higher wages than the non-immune. Therefore the newly arrived Spaniards were very willing to go into Dr. REED'S camp where the experiments were carried on. When the patient could present a certificate of immunity he could demand double wages and was moreover protected for all time. General Gorgas believes that an attack of yellow fever gives as great or even greater immunity than an attack of small-pox. While in the experimental camp the volunteers were well treated, obtained immunity with a mild attack of yellow fever and at the end received two hundred and fifty dollars. A story full of grim humour on pages 30 and 31 shows that the American soldiers on guard took steps to acquire these benefits and dollars for themselves.

It is not necessary to go into the details of the experiments and even the conclusions may be briefly stated. They should be known to members of the medical profession. Briefly stated the Commission's results were :— That yellow fever is conveyed from man to man by the female *Stegomyia fasciata* and that to become infected the mosquito must bite the patient during the first three days of his disease. Twelve to twenty days must elapse before the mosquito can cause infection in man. Blood taken from a patient during the first three days and injected into a non-immune will produce yellow fever. Individual Stegomyia remain infectious for long periods.

Major Gorgas (as he then was) accepted the findings of the "Reed Commission" and with his junior assistants and large sanitary staff sought ways of making practical application of the new knowledge. Vaccination was tried, non-immunes being admitted into the Las Animas Hospital. An infected mosquito was allowed to bite the patient in the hope that a mild attack would follow, with subsequent protection. Unfortunately the dose conveyed by the mosquito could not be controlled and several of the experimental cases showed severe symptoms and three cases died. This was a grave disappointment because the cases produced in the same way in the "Commission" camp had all been mild in type. Clearly vaccination would not do. Since the mosquito to become infected had to bite a case of yellow fever during the first three days, if such an accident could be prevented in every case the disease would disappear. It was made compulsory to report all supposed cases to the Health Department. Each case was examined by a special diagnosis Commission and if found to be a true case of yellow fever was removed to screened wards in the Las Animas Hospital. If the patient wished to be treated at home skilled carpenters were sent to screen certain rooms. Guards were placed over the screened doors. This method was of no value unless the case was seen very early. If mosquitoes had already been infected there still remained twelve or fourteen days before they could pass on the infection. *Stegomyia fasciata* is a "house mosquito" and therefore not likely to go far from the room or house in which she became infected. The next step, therefore,

was to destroy all mosquitoes in the sick man's house and in adjoining houses. This was done by specially appointed gangs who sealed the houses and fumigated with sulphur, pyrethrum, or tobacco. The reasons for using one or other fumigant are given in Chapter V. It was made punishable to allow Stegomyia larvae to breed in tubs, tins, etc., and all water tubs were screened. With great wisdom the power to inflict fines was placed in the hands of the Sanitary Officer. The City was divided into areas for inspection. Of the actual methods employed to check the breeding of Stegomyia and Anopheles and to protect mankind from their bites no more need be said as these matters will be referred to in the review which follows. At the end of 1902 yellow fever had practically disappeared from the City of Havanna.

Similar attention was paid by the Sanitary Staff under Major Gorgas to the Anopheles mosquitoes, carriers of the Plasmodium of malaria. Screening of houses, oiling and cleaning of spots where they might breed and the use of quinine for prophylaxis and treatment reduced the number of deaths from malaria from 325 in 1900 to 4 in 1912. As General Gorgas says :—" Four deaths from malaria can very safely be put down as coming from the outside and it can with equal safety be said that by 1912 malaria had become as completely extinguished in Havanna, as had yellow fever in 1902."

Chapter VII. contains letters connected with the work in Havanna which passed between Dr. Reed, writing from the Surgeon-General's Office in Washington, and Major Gorgas. These letters show enthusiasm on one side and friendly help and encouragement on the other. The next two chapters are taken up with the history and geographical distribution of yellow fever and then, with Chapter X, we come to Sanitation in Panama.

In 1902 Major Gorgas pointed out how useful the discoveries made in Havanna might be in connection with medical arrangements in the Canal Zone. How Major Gorgas was appointed Chief Sanitary Officer in April 1904 is told in the same Chapter and the rest of the book contains a most attractive account of sanitary work in Panama, of initial difficulties overcome and of good results achieved. Armed with weapons fashioned in Cuba Major Gorgas and his staff were ready to undertake the greater and more difficult enterprise in the Canal Zone. All praise is due to them for years of patient and successful labour often hindered by thoughtless critics.

Although the chief object of the work under review has been to relate successful results in the war against *Stegomyia fasciata*, and such species of Anopheles as carry the Plasmodium of malaria other diseases are not forgotten. General Gorgas' book contains a useful Chapter on plague and the precautions taken to prevent infection. " Sanitation in Panama " is furnished with a map of the Canal Zone and some clear and useful photographs illustrating the text. General Gorgas has written a book that everyone may read with pleasure and profit.

J. H. Tull Walsh.

Le Prince (Joseph A.) [C.E., A.M.] & Orenstein (A. J.) [M.D.]. **Mosquito Control in Panama. The Eradication of Malaria and Yellow Fever in Cuba and Panama.** With an Introduction by L. O. Howard, [Ph.D., LL.D.].—xvii + 335 pp. Demy 8vo. With 100 illustrations. 1916. New York and London: G. P. Putnam's Sons. [Price 10*s.* 6*d.* net.]

Mr. Joseph Le Prince had the advantage of training and experience under Major Gorgas in Havanna. When Major Gorgas was transferred to the Panama Canal Zone as Chief Medical and Sanitary Officer Mr. Le Prince was appointed Chief Sanitary Inspector of the " Isthmian Canal Commission." He held that post from 1904 to 1914. Dr. A. J. Orenstein was Assistant Chief Sanitary Inspector. " Mosquito Control in Panama " bears the same relation to " Sanitation in Panama " that a laboratory manual bears to a general text book. It deals exhaustively with the various methods tried and adopted in Cuba and in Panama for the purpose of protecting man against mosquito-borne disease. The two diseases

with which the work is mainly occupied are yellow fever, spread by the *Stegomyia fasciata* and "Malaria," carried from man to man by certain species of Anopheles.

Dr. Howard's Introduction is brief. It bears witness to wise foresight on the part of President ROOSEVELT and to the happy enthusiasm with which Mr. Le Prince entered upon his duties as Inspector. The President let it be known that with regard to the medical and sanitary arrangements in the Canal Zone "it was his intention to seek for the best man in the world for the task, to pay him whatever would be necessary and to give him full power." Owing to his former experience Col. GORGAS was the best man available and the results achieved show that he was loyally supported by the members of his staff into whose hands the executive details fell. What those details were and the means through which the results were attained are clearly set out in "Mosquito Control in Panama."

The book is divided into two parts: Part I. deals with the "Anti-Malaria Campaign," while Part II., a much shorter record, tells of "The Yellow Fever Campaign." To understand how serious was the outlook in 1904 one must remember that the Canal Zone was forty-eight miles long, ten miles wide, in the torrid zone, with a mean annual temperature of about 80° F. and a long rainy season. It was a mass of swamp and jungle and "climate and temperature are favourable to mosquito propagation the year round." Along the railroad, already established, were many villages, "filthy, without regulations or restrictions, without sewers and having the usual water supply of the country, viz., rain water during the wet season and water from streams during the dry season." The camps used by the French were in much the same insanitary conditions and mosquitoes swarmed throughout the area. Malarial fever was very prevalent and of Corozal, a village near Panama, it was said by the coloured people that "to live there is to be sick and die." There were hospitals that had been built by the French, that at Ancon being large and well situated, but mosquitoes filled the wards and patients admitted for trivial injuries often contracted yellow fever or malaria and thus the hospitals got a bad reputation.

If only because of the "articulate monotony" no mosquito is altogether acceptable but it is necessary to distinguish the homicidal criminals from the mere hooligans. Mosquitoes from the Canal Zone were collected, and identified by Mr. F. KNAB. A list of Anophelines from Panama is given on page 52. "Biting experiments were made by Dr. Darling to determine which of the Isthmian Anopheles were malaria carriers." *A. albimanus*, Wied., *A. tarsimaculata* Goeldi, and *A. pseudopunctipennis* became infected and the first named was found to be the "all-important" transmitter of malarial fever. Anopheles as a rule were absent from dwellings, their breeding places being generally "seepage outcrops, pools, ponds, lagoons, ditches, streams and the edges of rivers." The habits of these mosquitoes and their larvae are described and the propagation areas considered in Chapters IV. to VII. Chapter VII. is full of interesting information as to the flight of mosquitoes, and as the result of the numerous observations it was shown that the "Anopheles knew where they desired to go" and that they could fly against the wind, making long flights to reach groups of inhabited houses. *Stegomyia fasciata*, always called *Aëdes calopus* D.K. in Mr. Le Prince's book, is a weak flier and rarely moves far from her breeding place in or near inhabited houses.

Chapter VIII. introduces us to the anti-malarial work with means of attack on breeding areas by filling them up. Drainage is dealt with in Chapter IX and this is followed by chapters full of detail showing the reader how best to destroy breeding areas and larvae by oiling, by the use of "larvacides," by encouraging natural enemies, and by clearing water plants, algae and jungle from ditches, ponds and the margins of streams. Methods of screening houses and methods for the destruction of adult mosquitoes fill Chapter XV. with excellent and most useful instruction and Chapter XVI., giving the results achieved, brings us to the end of Part I. As Mr. Le Prince rightly says "the methods of malaria control" were "put to a severe test" on the Isthmus and "they gave successful results."

It is no part of a reviewer's duty to eviscerate a good and useful book for the satisfaction of desultory readers. "Mosquito Control in Panama" is a practical manual worth buying and no young medical officer working in the tropics should fail to possess it. It will be found "a very present help" in all kinds of difficulties which may and do arise where insect-borne diseases are prevalent. Part II. which deals with the "Yellow Fever Campaign" is as satisfactory in its methods and results as Part I.

The book is full of excellent photographs, which are not only good as artistic illustrations but are very helpful to the reader. The work is well printed and free from errors and one can truly say that the authors of "Mosquito Control in Panama" have done a piece of work which will earn the gratitude of many workers in tropical climates.

J. H. Tull Walsh.

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